ORDER NO. VRD-7907-325

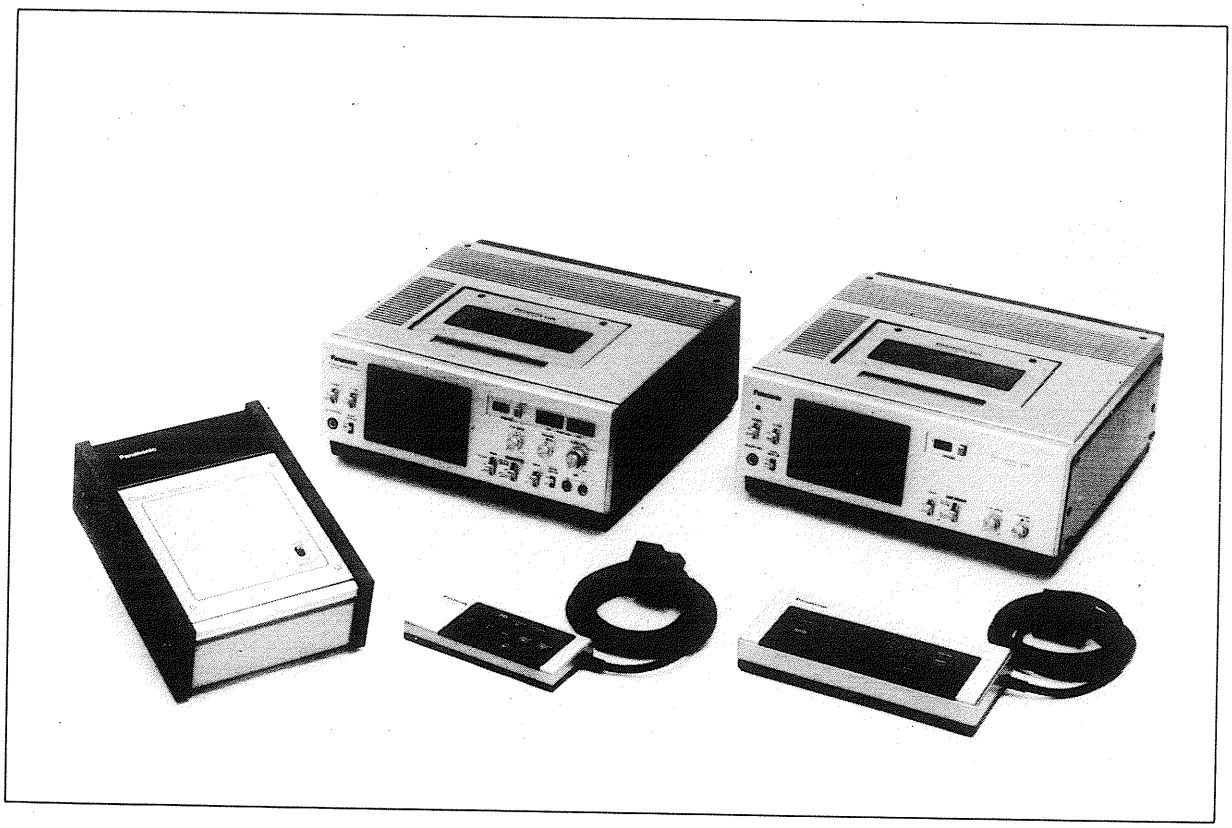
# Service Manual

Panasonic Omnivision II VHS

**Vol. 1**

***Operating Instructions***
***Circuit Description***

**NV-8200** Video Cassette Recorder
**NV-8170** Video Cassette Player
**NV-A800** Auto Search Controller
**NV-A810** Remote Controller
**NV-A820** Interface Adaptor



**Panasonic**


Panasonic Company
Division of Matsushita Electric
Corporation of America
One Panasonic Way, Secaucus,
New Jersey 07094

Panasonic Hawaii, Inc.
320 Waiakamilo Road, Honolulu,
Hawaii 96817

Matsushita Electric of Canada Limited
5770 Ambler Drive, Mississauga,
Ontario, L4W 2K9, canada

# INTRODUCTION

This Service Manual contains technical information which will allow service technicians to understand and service the Panasonic VHS Video Tape Recorder Model NV-8200 and Video Cassette Player Model NV-8170.

These units incorporate many special features including extended recording time of up to 2 hours, simplified and reliable new tape-loading method, a directly driven head cylinder, a rugged and reliable aluminum die-cast chassis, solenoid operation, options for numerical access, remote control, editing and two audio channels.

Additional features are unattended auto-repeat of a program, variable speed from 1/5-1.5X — with audio — plus X2 speed — with audio, still frame and single frame advance with automatic still frame compensation and damped eject. And, these units are lightweight and very compact.

These features in addition to the basic VHS format make the NV-8200 and NV-8170 ideal units for business, education, sales and training applications.

CONTENTS


INTRODUCTION ..... I
QUALITY ENGINEERING FEATURES ..... II
SPECIFICATIONS ..... VI
OPERATING INSTRUCTIONS ..... 1-1 - 1-32
CIRCUIT DESCRIPTIONS ..... 1-33
System Control ..... 1-33
  The purpose of each board ..... 1-33
  1. Play operation ..... 1-33
  2. Rew mode ..... 1-43
  3. FF mode ..... 1-45
  4. Eject mode ..... 1-46
  5. X2 mode ..... 1-51
  6. Slow mode ..... 1-54
  7. Moisture sensor ..... 1-57
  8. Still / pause mode ..... 1-58
  9. Sub loading circuit ..... 1-59
  10. To stop the sub-loading motor ..... 1-60
Servo Section ..... 1-63
  Cylinder servo basics --- record and playback ..... 1-63
  Capstan servo basics --- record and playback ..... 1-69
  Cylinder servo detail description ..... 1-70
  Head cylinder motor ..... 1-75
  Capstan servo detail description ..... 1-80
  Slow / still mode ..... 1-82
Luminance Recording Process ..... 1-89
Luminance Playback Process ..... 1-91
Video Head Current Flow ..... 1-99
Chrominance Recording Process ..... 1-103
Chrominance Playback Process ..... 1-114
Audio Circuit ..... 1-127
SEARCH CONTROLLER MODEL NV-A800 ..... 1-133
INTERFACE ADAPTOR MODEL NV-A820 ..... 1-143
MECHANICAL DESCRIPTION ..... 1-156
  1. Sub-loading Mode ..... 1-156
  2. Play Mode ..... 1-157
  3. Mechanism for Takeup ..... 1-158
  4. Mechanism for Rewind ..... 1-159
  5. Mechanism for Fast Forward ..... 1-159
  6. Mechanism for Eject ..... 1-160
  List of Functions ..... 1-160
  Switches and Their Functions ..... 1-161

## QUALITY ENGINEERING FEATURES

1. The first industrial 1/2" VHS recorder with solenoid controls. Non-locking "logic memory" pushbuttons let you change from FF/Play/Rew functions without using Stop. Accommodates optional Panasonic Auto-Search Controller, Remote Controller, and Editing Interface.

2. Numerical access of programs or program segments with optional NV-A800 Auto-Search Controller. Numerical identification (by seconds) of locations on the tape for fast access, forward or backward.

3. Remote control of all solenoid operating functions with optional NV-A810 Remote Controller. A 10-ft. extension cable is available.

4. Optional NV-A820 Editing Interface connects to Panasonic NV-A950 Editing Controller. With NV-9500A 3/4" Editing Recorder, NV-8200 can be used as source deck for VHS-to-3/4" editing.

5. Two audio channels, for stereo sound, bilingual applications, or audio dubbing. Dual audio meters for accurate level control.

6. Unattended auto-repeat of a program or program segment. Commercially available clock/timer can be added for automatic recording or playback.

7. Compact design for easy mobility.

8. Color or black-and-white recording and playback of compatible 1/2" VHS video cassettes. Economical 2-hour recording and playback time with Panasonic NV-T120 cassettes. 30 and 60 minute tapes are also available.

9. Still frame and single frame advance, with Automatic Still Frame Compensation to help produce clean stills. Still mode is automatically released after approx. 3 minutes.

10. Variable speed from 1/5-1.5X (with audio), plus X2 speed (with audio) for analysis or fast searching.

11. Damped eject mechanism.

12. In playback; video muting circuit keeps video monitor blank when the recorded material ends.

13. High picture quality, with a 45 dB signal-to-noise ratio.

14. High resolution: 300 lines monochrome, 240 lines color.

15. Direct-drive video head cylinder (DDC) motor for picture stability; crystal-oriented HPF™ video heads for long life and high performance.

16. Lightweight annealed aluminum diecast chassis provides strength and stability.

17. Keyed automatic gain control (AGC) for video level; manual gain control or with limiter for audio levels.

18. Built-in RF modulator switchable for channels 3 or 4, for playback on a conventional television receiver.

19. VTR/TV antenna switch for use with a TV receiver — selects RF output of VTR or external antenna.

20. In Stop/Rew/FF modes, video and audio input signals are fed to monitor.

21. Dew detector shuts machine off automatically in operating conditions that are too damp.

22. Low power consumption — just 50 watts.

23. 50 or 60 Hz operation for international adaptability.

24. Built-in handle lets you carry compact unit like a briefcase.

25. Convenience AC outlet (non-switched) on rear panel.

26. BNC video, RCA audio and 8-pin connectors; 1/4" phone jacks for front-panel microphone inputs.

27. Stereo headphone jack on front panel.

28. Cabinet constructed of individually removable side, top and bottom panels for easy access.

## NV-8170

QUALITY ENGINEERING FEATURES

1. The first industrial 1/2" VHS player with solenoid controls. Non-locking "logic memory" pushbuttons let you change from FF/Play/Rew functions without using Stop. Accommodates optional Panasonic Auto-Search Controller, Remote Controller, and Editing Interface.

2. Numerical access of programs or program segments with optional NV-A800 Auto-Search Controller. Numerical identification (by seconds) of locations on the tape for fast access, forward or backward.

3. Remote control of all solenoid operating functions with optional NV-A810 Remote Controller. A 10-ft. extension cable is available.

4. Optional NV-A820 Editing Interface connects to Panasonic NV-A950 Editing Controller, so NV-8170 can be used as a source player in an editing system.

5. Two audio channels, for stereo sound or bilingual applications.

6. Unattended auto-repeat of a program or program segment. Commercially available clock/timer can be added for automatic unattended playback.

7. Compact design for easy mobility.

8. Color or black-and-white playback of compatible 1/2" VHS video cassettes. Economical 2-hour playback time with Panasonic NV-T120 cassettes. 30 and 60 minute tapes are also available.

9. Still frame and single frame advance, with Automatic Still Frame Compensation to help produce clean stills. Still mode is automatically released after approx. 3 minutes.

10. Variable speed from 1/5-1.5X (with audio), plus X2 speed (with audio), for analysis or fast searching.

11. Damped eject mechanism.

12. Video muting circuit keeps video monitor blank when the recorded material ends.

13. High resolution: 300 lines monochrome, 240 lines color.

14. Direct-drive video head cylinder (DDC) motor for picture stability; crystal-oriented HPF™ video heads for long life and high performance.

15. Lightweight annealed aluminum diecast chassis provides strength and stability.

16. Built-in RF modulator switchable for channels 3 or 4, for playback on a conventional television receiver.

17. VTR/TV antenna switch for use with a TV receiver — selects RF output of VTR or external antenna.

18. Dew detector shuts machine off automatically in operating conditions that are too damp.

19. Low power consumption — just 43 watts.

20. 50 or 60 Hz operation for international adaptability.

21. Built-in handle lets you carry compact unit like a briefcase.

22. Convenience AC outlet (non-switched) on rear panel.

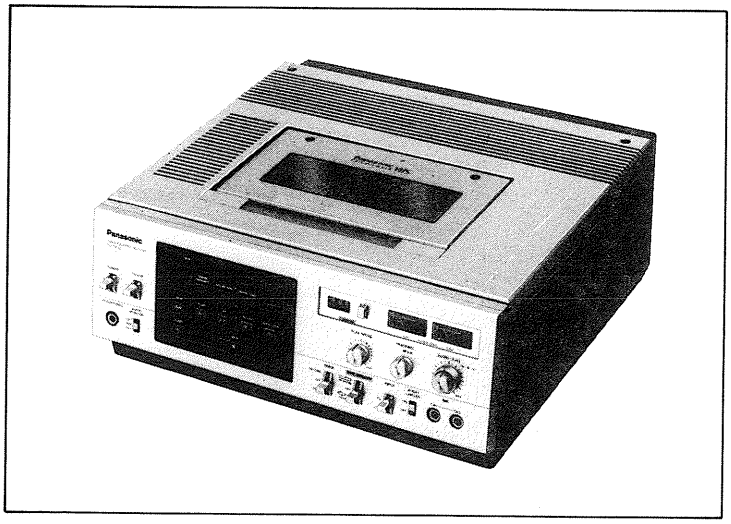
23. BNC video, RCA audio and 8-pin connectors.

24. Stereo headphone jack on front panel.

25. Cabinet constructed of individually removable side, top and bottom panels for easy access.

Video Cassette Recorder

# NV-8200



## SPECIFICATIONS

| | |
|---|---|
| Power Source: | 120 V AC, 60 Hz |
| Power Consumption: | Approx. 50 watts |
| Television System: | EIA Standard (525 lines, 60 fields) NTSC color signal |
| Video Recording System: | 2 rotary heads, helical scanning system<br>Luminance: FM azimuth recording<br>Color signal: converted subcarrier phase shift recording |
| Audio Track: | 2 tracks |
| Tape Format: | Tape width 1/2 inch (12.7 mm), high density tape |
| Tape Speed: | 1-5/16″ i.p.s. (33.35 mm/s) (Normal) |
| Relative Head to Tape Speed: | 19.03 ft./s (5.8 m/sec.) |
| Record/Playback Time: | 120 min. with NV-T120 |
| FF/REW Time: | Less than 4.5 min. with NV-T120 |
| Heads: | Video: 2 rotary heads<br>Audio/Control: 1 stationary head<br>Erase: 1 full track erase<br>1 audio track erase for audio dubbing |
| Input Level: | Video: TV Monitor connector (8 pins)<br>1.0 Vp-p, 75Ω unbalanced<br>VIDEO IN connector (BNC)<br>1.0 Vp-p, 75Ω unbalanced<br>Audio: TV Monitor connector (8 pins)<br>−20 dB, 100 kΩ unbalanced<br>MIC IN jack × 2<br>−70 dB, 600Ω unbalanced<br>LINE IN jack (RCA) × 2<br>−20 dB, 100 kΩ unbalanced |
| Output Level: | Video: TV Monitor connector (8 pins)<br>1.0 Vp-p, 75Ω unbalanced<br>VIDEO OUT connector (BNC)<br>1.0 Vp-p, 75Ω unbalanced<br>Audio: TV Monitor connector (8 pins)<br>0 dB, 5 kΩ unbalanced<br>LINE OUT jack (RCA) × 2<br>−6 dB, 600Ω unbalanced<br>AUDIO MONITOR OUT jack (RCA) 0 dB, 5 kΩ unbalanced<br>HEADPHONE jack<br>−32 dB, 8Ω unbalanced |
| RF Modulated: | Channel 3 or 4<br>75 dBμ (open voltage), 75Ω unbalanced |
| Video Horizontal Resolution: (on monoscope test pattern) | Color: more than 240 lines<br>B/W: more than 300 lines |
| Audio Frequency Response: | 50—10,000 Hz |
| Signal-to-Noise Ratio: | Video: better than 45 dB (Rohde & Schwarz noise meter)<br>Audio: better than 40 dB |
| Operating Temperature: | 41°F—104°F (5°C—40°C) |
| Operating Humidity: | 35%—80% |
| Weight: | 34-1/8 lbs. (15.5 kg) |
| Dimensions: | 15-1/8″(W) × 15-1/8″(D) × 6-1/4″(H)<br>(382(W) × 382(D) × 156(H) mm) |
| Accessories Supplied: | 1 pc. Video cassette tape, NV-T60<br>1 pc. 300Ω—75Ω transformer, VSQ0057<br>1 pc. F-F coaxial cable, VJA0103<br>2 pcs. Twin lead cable, VJA0102<br>1 pc. F connector, VSQ0051<br>1 pc. Protect cover, VYF0154<br>1 pc. Terminal block, VJH0091 |
| Optional Accessories: | 1/2″ video cassette tape:<br>NV-T120 Approx. 810 ft. (247 m) 120 min.<br>NV-T60 Approx. 417 ft. (127 m), 60 min.<br>NV-T30 Approx. 210 ft. (64 m), 30 min.<br>Carrying case, NV-H80<br>Remote controller, NV-A810 Approx. 10 ft. (3 m)<br>Auto search controller, NV-A800 Approx. 6.6 ft. (2 m)<br>Interface adaptor, NV-A820<br>VTR-Monitor connection cable |

Specifications are subject to change without notice.

Video Cassette Player

# NV-8170

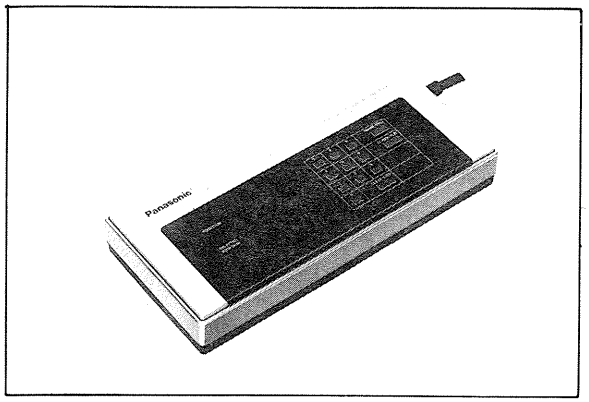
## SPECIFICATIONS

| | |
|---|---|
| Power Source: | 120 V AC, 60 Hz |
| Power Consumption: | Approx. 45 watts |
| Television System: | EIA Standard (525 lines, 60 fields) NTSC color signal |
| Video Recording System: | 2 rotary heads, helical scanning system<br>Luminance: FM azimuth recording<br>Color signal: converted subcarrier phase shift recording |
| Audio Track: | 2 tracks |
| Tape Format: | Tape width 1/2 inch (12.7 mm), high density tape |
| Tape Speed: | 1-5/16″ i.p.s. (33.35 mm/s) (Normal) |
| Relative Head to Tape Speed: | 19.03 ft./s (5.8 m/sec.) |
| Record/Playback Time: | 120 min. with NV-T120 |
| FF/REW Time: | Less than 4.5 min. with NV-T120 |
| Heads: | Video: 2 rotary heads<br>Audio/Control: 1 stationary head |
| Output Level: | Video: TV Monitor connector (8 pins) 1.0 Vp-p, 75Ω unbalanced<br>VIDEO OUT connector (BNC) 1.0 Vp-p, 75Ω unbalanced<br>Audio: TV Monitor connector (8 pins) 0 dB, 5 kΩ unbalanced<br>LINE OUT jack (RCA) × 2 −6 dB, 600Ω unbalanced<br>AUDIO MONITOR OUT jack (RCA) 0 dB, 5 kΩ unbalanced<br>HEADPHONE jack −32 dB, 8Ω unbalanced<br>RF Modulated: Channel 3 or 4 75 dBμ (open voltage), 75Ω unbalanced |
| Video Horizontal Resolution: (on monoscope test pattern) | Color: more than 240 lines<br>B/W: more than 300 lines |
| Audio Frequency Response: | 50—10,000 Hz |
| Signal-to-Noise Ratio: | Video: better than 45 dB (Rohde & Schwarz noise meter)<br>Audio: better than 40 dB |
| Operating Temperature: | 41°F—104°F (5°C—40°C) |
| Operating Humidity: | 35%—80% |
| Weight: | 33.0 lbs. (15.0 kg) |
| Dimensions: | 15-1/8″(W) × 15-1/8″(D) × 6-1/4″(H) (382(W) × 382(D) × 156(H) mm) |
| Accessories Supplied: | 1 pc. 300Ω—75Ω transformer, VSQ0057<br>1 pc. F-F coaxial cable, VJA0103<br>2 pcs. Twin lead cable, VJA0102<br>1 pc. F connector, VSQ0051<br>1 pc. Protect cover, VYF0154<br>1 pc. Terminal block, VJH0091 |
| Optional Accessories: | 1/2″ video cassette tape:<br>NV-T120 Approx. 810 ft. (247 m) 120 min.<br>NV-T60 Approx. 417 ft. (127 m), 60 min.<br>NV-T30 Approx. 210 ft. (64 m), 30 min.<br>Carrying case, NV-H80<br>Remote controller, NV-A810 Approx. 10 ft. (3 m)<br>Auto search controller, NV-A800 Approx. 6.6 ft. (2 m)<br>Interface adaptor, NV-A820<br>VTR-Monitor connection cable |

Specifications are subject to change without notice.

## Auto Search Controller

# NV-A800




### SPECIFICATIONS

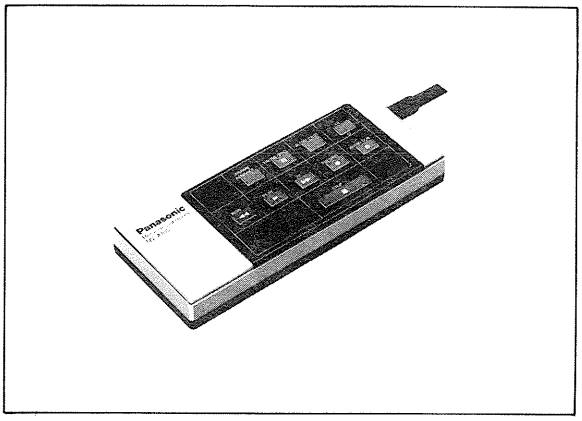
| | |
|---|---|
| Dimensions: | 10-1/8″(W) × 4-5/8″(D))1-1/2″(H) |
| | 255(W) × 117(D) × 38(H)mm |
| Weight: | Approx. 1.8 lbs. (0.8kg) |
| Standard Cable Length: | Approx. 6.6ft. (2m) |
| Connector: | 34 pin male plug |
| Display Readout in Seconds: | Accuracy ±1 second |
| Optionary Accessory: | Extension cable, NV-C80 Approx. 16.4ft. (5m) |
| | (As many as 3 extension cable can be connected.) |

Weight and dimensions shown are approximate.
Specifications are subject to change without notice.

---

## Remote Controller

# NV-A810




### SPECIFICATIONS

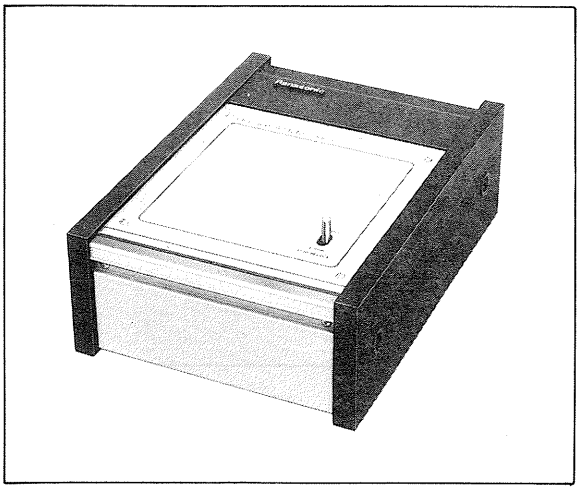
| | |
|---|---|
| Dimensions: | 7-3/8″ × 3-1/8″ × 1″ |
| | (186 × 79 × 25.2mm) |
| Weight: | Approx. 1.1 lbs. (0.5kg) |
| Standard Cable Length: | Approx. 9.8ft. (3m) |
| Connector: | 34 pin male plug |
| Optional Accessory: | Extension cable, NV-C80 Approx. 16.4ft. (5m) |
| | (As many as 3 extension cable can be connected.) |

Weight and dimensions shown are approximate.
Specifications are subject to change without notice.

---

## Interface Adaptor

# NV-A820



### SPECIFICATIONS

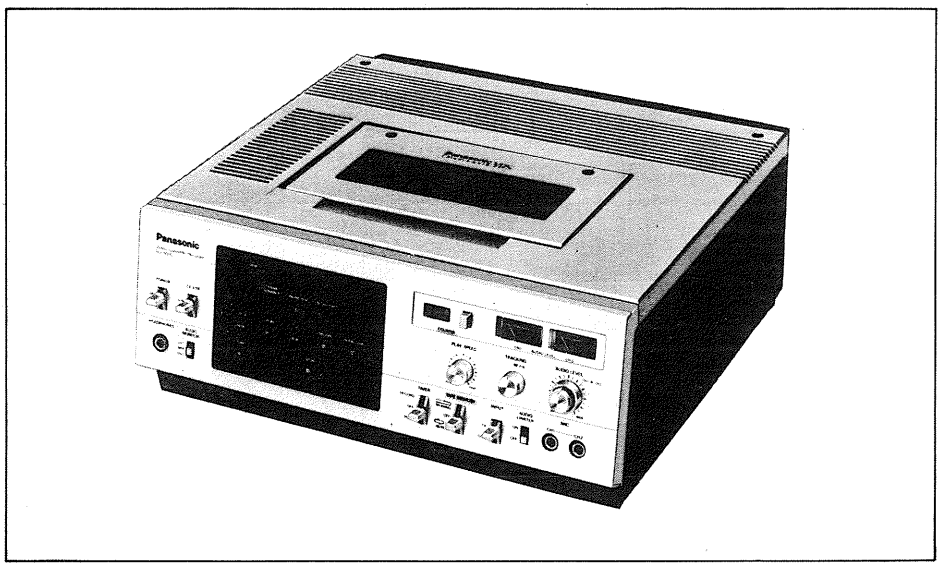
| | |
|---|---|
| Power Source: | DC 12V (supplied from NV-8200, NV-8170, |
| | or NV-9000 series) |
| Power Consumption: | 2.4W |
| Connection Cable: | 34-pin cable |
| Cable Length: | 3.3ft. (1m) |
| Operating Temperature: | 41°F ~ 104°F (5°C ~ 40°C) |
| Dimensions: | 8-1/8″(W) × 11-1/2″(D) × 4-7/8″(H) |
| | 206(W) × 290(D) × 122(H)mm |
| Weight: | Approx. 6.6 lbs. (3kg) |
| Accessories Supplied: | 1 pc. Connection cable, VJA0135, 3.3ft. (1m) |

Weight and dimensions shown are approximate.
Specifications are subject to change without notice.

# Operating Instructions

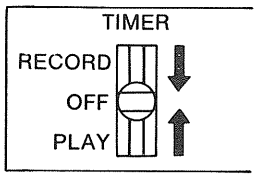
Video Cassette Recorder

## NV-8200

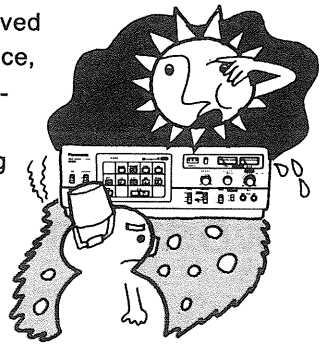


# PRECAUTIONS

Before trying to operate the unit, be sure that the Timer Switch on the front panel is set to OFF.

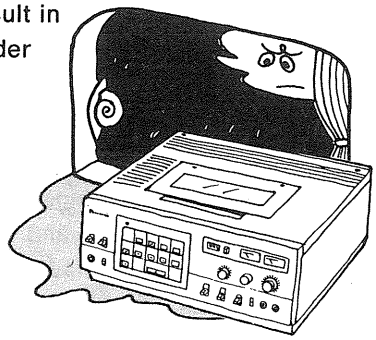



If this unit is suddenly moved from a cold to a warm place, condensation may form inside.
Avoid operating or leaving the unit in a hot or cold place.

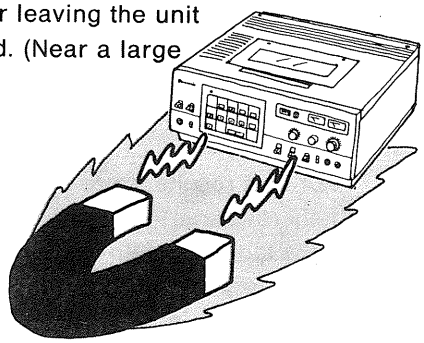


Do not insert fingers or any other object into the video cassette compartment.

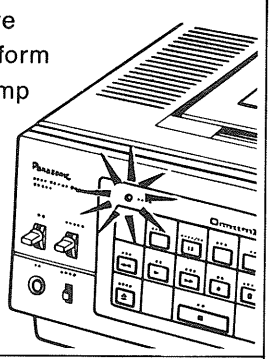
Avoid operating or storing the unit in an excessively hot, cold, or damp environment as this may result in damage to the recorder and to the tape.



Avoid operating or leaving the unit in a magnetic field. (Near a large motor or power transformer, etc.)



If, as described above, excessive moisture or condensation does form inside the recorder, the DEW lamp will light if the power is ON.
While the DEW lamp is lit, the unit will not function.
Let the unit remain a room temperature with power ON until the DEW lamp is no longer lit.



- Do not block the ventilation slots on the top and bottom of the unit.
- Use this unit horizontally and do not place anything on the top panel.
- Cassette tape can be used only for one-side, one direction recording, two-way or two-track recordings cannot be made.
- Cassette tape can be used for either Color or Black & White recording.
- This unit is supplied with a 3-prong grounded AC plug—do not try to defeat its purpose.
- Do not spray any cleaner or wax directly on the unit.
- If the unit is not going to be used for a length of time, protect it from dirt and dust by using the protect cover.
- Do not leave a cassette in the recorder when not in use.
- Do not attempt to disassemble the recorder. There are no user serviceable parts inside.
- If any liquid spills inside the recorder, have the recorder examined for possible damage.
- Refer any needed servicing to qualified service personnel.

**"Unauthorized recording of copyrighted television programs, films, video tapes and other materials may infringe the right of copyright owners and be contrary to copyright laws."**

**Note:**

- Please read the attached limited warranty card completely.

**If you use the NV-8200 with a "VIR" type television set, the playback picture may appear to have improperly adjusted color. If this happens, you may want to turn the television's "VIR" switch off and adjust the color tint and intensity to your preference. (This applies to "VIR" television sets only, which have a special "VIR" switch.)**

## FOR YOUR SAFETY

**WARNING: TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE.**

# THE VHS FORMAT

This recorder operates on the 2-hour standard VHS tape format. Tapes recorded on this unit are compatible with every other VHS recorder or player, regardless of manufacturer. This 2-hour standard is called "SP" for Standard Play.

There are other VHS units available which operate on a 2-hour or 4-hour format. The 4-hour recordings made by these units are called "LP" for Long Play. The NV-8200 VHS recorder cannot play an LP recording.

# A WORD ABOUT THE CASSETTE

■ **Types of Cassette Tape**

| |
|---|
| NV-T120 (for 120 minutes of recording and playback) |
| NV-T60 (for 60 minutes of recording and playback) |
| NV-T30 (for 30 minutes of recording and playback) |

In addition to the tapes specified above, the recorder will accept any cassette tape which has the VHS mark.

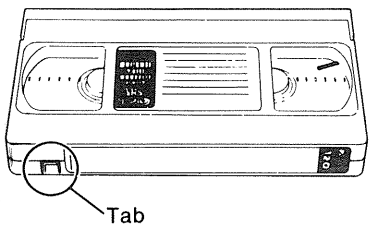
■ Note that video recordings are made across the entire width of the tape and, therefore, two-way recordings cannot be made.

■ The VHS cassette must be inserted into the recorder with the label side up. It cannot be used upside down.

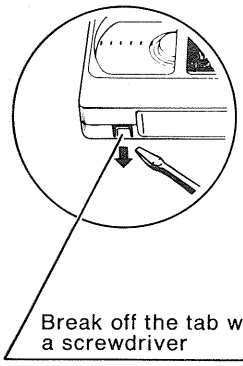
■ To prevent accidental erasure of recorded material, the VHS cassette has a removable tab on the rear side.

The tab can be broken off by a small screwdriver. After it has been removed, the tape can be used for playback only.

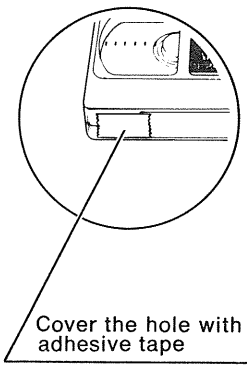
To record on a cassette from which the tab has been removed, simply cover the hole with a piece of adhesive tape.




To prevent accidental erasure




To record again




■ To prevent accidental damage to the tape and recorder caused by moisture from condensation, be sure that the video cassette is kept at room temperature for at least 1 hour before being used.

Use of a cold cassette in a warm recorder could result in the formation of moisture or dew on the tape, which might damage the tape or recorder.

■ **To store:**

Always put the cassette back in its case before storage.

Store in a vertical position.

Keep in a cool, dry place. Avoid storage in direct sunlight or near sources of heat. Do not place a recorded cassette in a magnetic field, such as that produced by an electric motor or power transformer...the magnetic field might accidentally erase the tape.

Do not drop or otherwise subject the cassette to shock impact.

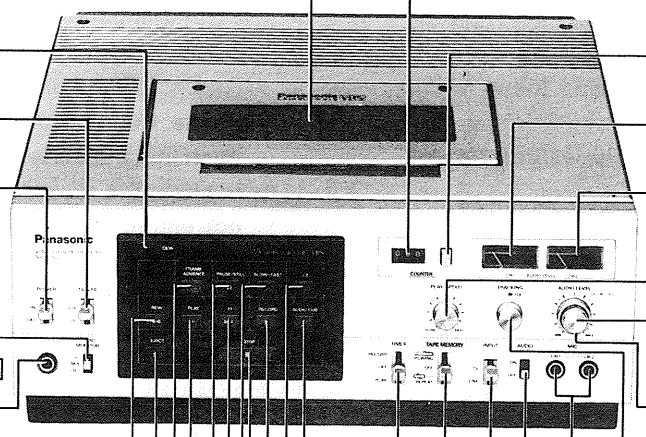
For best results, store the cassette with the tape fully rewound.

If the tape has been rewound unevenly, rewind it again to pack the tape properly.

* The tape in a VHS cassette should not be spliced. Do not attempt to repair or open the cassette.
* Do not touch the tape surface itself. Dirt and oil from your skin may deteriorate the tape coating.

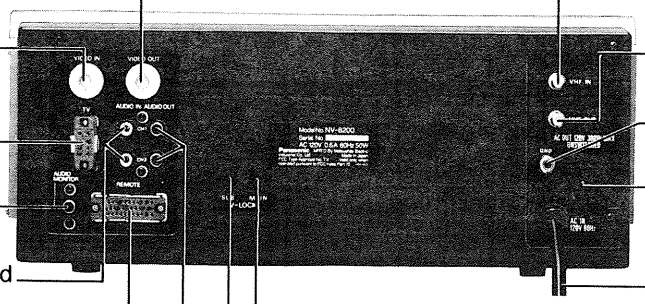
# MAJOR OPERATING COMPONENTS

## TOP and FRONT



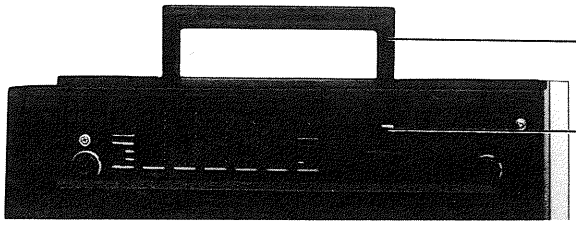
① Cassette Compartment
② Dew Lamp [DEW]
③ TV/VTR Selector [TV/VTR]
④ Power Switch [POWER]
⑤ Audio Monitor Channel Selector [AUDIO MONITOR]
⑥ Headphone Jack [HEADPHONES]
⑦ Rewind Button [REW]
⑧ Eject Button [EJECT]
⑨ One-Shot Frame Advance Button [FRAME ADVANCE]
⑩ Play Button [PLAY]
⑪ Pause Button [PAUSE/STILL]
⑫ Fast Forward Button [FF]
⑬ Slow-Fast Button [SLOW-FAST]
⑭ Stop Button [STOP]
⑮ Record Button [RECORD]
⑯ Double Speed Button [×2]
⑰ Audio Dubbing Button [AUDIO DUB]
⑱ Tape Counter [COUNTER]
⑲ Tape Counter Reset Button
⑳ Audio Recording Level Meter, Ch 1
㉑ Audio Recording Level Meter, Ch 2
㉒ Play Speed Control [PLAY SPEED]
㉓ Audio Recording Level Control, Ch 1
㉔ Audio Recording Level Control, Ch 2
㉕ Tracking Control [TRACKING]
㉖ Microphone Input Jacks, Ch 1 and Ch 2 [MIC]
㉗ Audio Limiter Selector [AUDIO LIMITER]
㉘ Input Signal Selector [INPUT]
㉙ Tape Memory Switch [TAPE MEMORY]
㉚ Timer Switch [TIMER]

## REAR



㉛ Video Output Connector [VIDEO OUT]
㉜ Video Input Connector [VIDEO IN]
㉝ TV/VIDEO Monitor Connector [TV]
㉞ Audio Monitor Output Jack [AUDIO MONITOR]
㉟ Audio Input Jacks, Ch 1 and Ch 2 [AUDIO IN]
㊱ Remote Control Connector [REMOTE]
㊲ Audio Output Jacks, Ch 1 and Ch 2 [AUDIO OUT]
㊳ Vertical Lock Adjuster Sub [V-LOCK SUB]
㊴ Vertical Lock Adjuster Main [V-LOCK MAIN]
㊵ VHF Antenna Input Connector [VHF IN]
㊶ VHF Antenna Output Connector [VHF OUT]
㊷ Ground Terminal [GND]
㊸ AC Outlet
㊹ AC Power Cord

## BOTTOM



㊺ Handle
㊻ RF Converter Channel Selector

# OPERATING COMPONENTS AND THEIR FUNCTIONS

## TOP and FRONT

① **Cassette Compartment**
For insertion of the video cassette.

② **Dew Lamp [DEW]**
This lamp illuminates if condensation (dew) is present inside the recorder.
When this lamp is on, the recorder will not operate until it has dried sufficiently.

③ **TV/VTR Selector [TV/VTR]**
This switch selects one of two signals which will be seen on the TV.
Place it in the "VTR" position to view playback pictures or to see the picture you are recording. Place it in the "TV" position to use your TV as you normally would.

④ **Power Switch [POWER]**
This switch is used to turn the recorder on and off.

⑤ **Audio Monitor Channel Selector [AUDIO MONITOR]**
This switch selects which audio channel is monitored during recording and playback. It does not affect the recorded audio signal.

CH1: Audio channel 1 can be monitored on the TV or through Audio Monitor Output Jack ㉞.

CH2: Audio channel 2 can be monitored on the TV or through Audio Monitor Output Jack ㉞.

MIX: Mixed sound from both channel 1 and channel 2 can be monitored on the TV or through Audio Monitor Output Jack ㉞.

⑥ **HEADPHONE JACK [HEADPHONES]**
Permits listening by headphones to each channel or both audio channels simultaneously, by selecting Audio Monitor Channel Selector ⑤.

⑦ **Rewind Button [REW]**
Push this button to rewind the tape. When in rewind, the tape will stop automatically when fully rewound, or at the counter "999" position, with the Tape Memory Switch ㉙ set to "REWIND".

⑧ **Eject Button [EJECT]**
Push this button to raise the cassette compartment to either insert or remove a cassette.

⑨ **One-Shot Frame Advance Button [FRAME ADVANCE]**
During a still picture, push this button to advance the picture by one frame at a time.

⑩ **Play Button [PLAY]**
Push this button to play back a recorded tape. If recording is desired, push the Play Button and the Record Button ⑮ simultaneously.

⑪ **Pause Button [PAUSE/STILL]**
Push this button to instantly stop the tape movement in either the record or playback modes. The tape will not unload, but its forward movement will stop. A still frame picture will appear in the playback mode, a one-shot picture can also be obtained. No still picture will appear in the pause-record mode, just the input signal will be seen. Push the Pause Button again to release pause. See page 10 for details.

⑫ **Fast Forward Button [FF]**
Push this button to quickly move the tape in the forward direction.

⑬ **Slow-Fast Button [SLOW-FAST]**
Push this button to start slow-fast motion. The slow-fast speed can be varied from 1/5 to 1.5 times normal motion by adjusting the Play Speed Control ㉒.

⑭ **Stop Button [STOP]**
Push this button to stop the Recording, Playback, Rewind, Fast Forward, or Audio Dubbing mode.

⑮ **Record Button [RECORD]**
This button should be pushed simultaneously with the Play Button ⑩ to start recording both picture and sound.

⑯ **Double Speed Button [×2]**
Push this button to obtain a double speed playback picture.

⑰ **Audio Dubbing Button [AUDIO DUB]**
During playback, audio dub may be started by pushing Play Button ⑩ and Audio Dub Button at the same time. This is handy when it is desired to narrate over a prerecorded tape. (Channel 2 only is used for DUB.) See page 22.

⑱ **Tape Counter [COUNTER]**
This is a digital counter which gives a reference to how far the tape has moved.

⑲ **Tape Counter Reset Button**
Press this button to reset the Tape Counter ⑱ to "000".

⑳ **Audio Recording Level Meter, Ch 1**
This meter shows the audio Ch1 recording level.

㉑ **Audio Recording Level Meter, Ch 2**
This meter shows the audio Ch2 recording level.

㉒ **Play Speed Control [PLAY SPEED]**
Slow-fast speed can be varied from 1/5 to 1.5 times normal motion by this control when the Slow-Fast Button ⑬ is pushed.

㉓ **Audio Recording Level Control, Ch1**
Audio recording level for Channel 1 is manually adjusted by this control.
Should be adjusted so that the Audio Level Meter, Ch1 ⑳ indicates 0 dB on peaks.

㉔ **Audio Recording Level Control, Ch 2**
Audio recording level for Channel 2 is manually adjusted by this control.
Should be adjusted so that the Audio Level Meter, Ch2 ㉑ indicates 0 dB on peaks.

㉕ **Tracking Control [TRACKING]**
This control is used to shift playback scanning of the tape.
Normally, it is left in the "FIX" position. It should only be adjusted if, upon playback, the picture appears very noisy or streaked.

㉖ **Microphone Input Jacks, CH1 and CH2 [MIC]**
This is for the connection of a microphone to record sound onto the tape. It can be used both in recording and for audio dubbing.

㉗ **Audio Limiter Selector [AUDIO LIMITER]**
If the dynamic range of the audio signal to be recorded is very wide, set this switch ON to provide automatic limiting of the signal peaks.

㉘ **Input Signal Selector [INPUT]**
This switch is used to select between 2 incoming signals from which recordings can be made.
1) In the "TV" position, the signal which is connected to the TV/VIDEO Monitor Connector ㉝ will be sent to the recording circuit.
2) In the "LINE" position, the signal which is connected to the Video Input Connector ㉜ will be sent to the recording circuit.

㉙ **Tape Memory Switch [TAPE MEMORY]**
REWIND: For automatic Tape Counter ⑱ "999" operation, see page 28.
OFF: For ordinary use of the unit when set to this position.
REPEAT: For automatic repeat during start and Tape Counter ⑱ "000" operation, see page 28.

㉚ **Timer Switch [TIMER]**
REC: For recording with the timer, see page 24.
OFF: Normally set to this position.
PLAY: For playback with the timer, see page 26.

## REAR

㉛ **Video Output Connector [VIDEO OUT]**
For direct connection to a video monitor. Not used with a conventional TV receiver.

㉜ **Video Input Connector [VIDEO IN]**
For connection of a video camera or other input video signal to be recorded.

㉝ **TV/VIDEO Monitor Connector [TV]**
For connection of a TV/VIDEO monitor (having an 8-pin terminal) by using an optional VTR-Monitor connection cable.

㉞ **Audio Monitor Output Jack [AUDIO MONITOR]**
For connection to an audio amplifier. Or audio input of a TV monitor unit to allow monitoring of channel 1 or channel 2 or mix audio, as selected by Audio Monitor Channel Selector ⑤.

**Note:**
TV sound cannot be heard if stereo equipment is connected to the Audio Monitor Output Jack and a short-circuit condition is created, but this is not malfunction.

㉟ **Audio Input Jacks, CH1 and CH2 [AUDIO IN]**
Used to record line level signals from an audio tape recorder or radio or record player (pin jack terminal).

㊱ **Remote Control Connector [REMOTE]**
For connection of optional remote controller (NV-A810) or auto search controller (NV-A800).
If the interface adaptor (NV-A820) is connected, tape editing can be simply accomplished.
Refer to pages 29 and 30.

㊲ **Audio Output Jacks, CH1 and CH2 [AUDIO OUT]**
For connection to a stereo amplifier, etc.

㊳ **Vertical Lock Adjuster Sub [V-LOCK SUB]**
If vertical "jitter" of still pictures cannot be corrected by adjusting the Vertical Lock Adjuster Main ㊴, remove the rubber cap and turn the control clockwise, by using a flat-tip screwdriver or similar tool. Then adjust the Vertical Lock Adjuster Main once again.

㊴ **Vertical Lock Adjuster Main [V-LOCK MAIN]**
Vertical "jitter" may be caused, during still picture playback, as a result of the connections between this unit and the TV set. To correct this, remove the rubber cap, and make the adjustment by using a flat-tip screwdriver or similar tool.

㊵ **VHF Antenna Input Connector [VHF IN]**
This is where the VHF antenna or CATV cable is connected to the recorder. The connector is a standard "F" type connector and requires that the connector on the antenna lead or CATV cable lead also be of the "F" type.

㊶ **VHF Antenna Output Connector [VHF OUT]**
This connects to the VHF input of a conventional TV receiver. The connector is a standard type "F" connector and requires that the cable used between the recorder and your TV should also have type "F" connectors.

㊷ **Ground Terminal [GND]**
Connect to external ground, if audio hum or buzz is heard while monitoring or playback.

㊸ **AC Outlet**
Convenience outlet for another appliance, 120 V AC and not more than 300 watts.

㊹ **AC Power Cord**
For connection to 120 V AC, 60 Hz electric outlet. This plug is a 3-prong grounded type. Do not defeat its purpose.

## BOTTOM

㊺ **Handle**

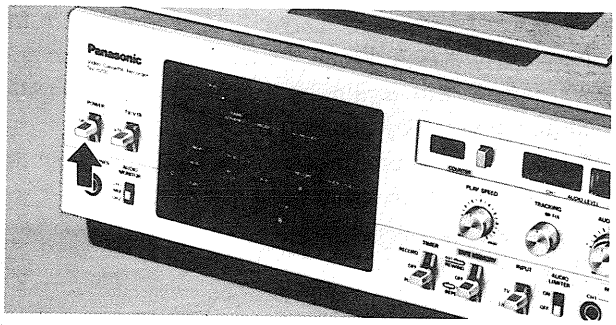
㊻ **RF Converter Channel Selector**
Move the switch to CH3 or CH4 (use a small screwdriver) whichever channel is not broadcast in your location.
See page 18.

# BASIC OPERATION AND FUNCTIONS

## INSERTION AND REMOVAL OF THE CASSETTE TAPE

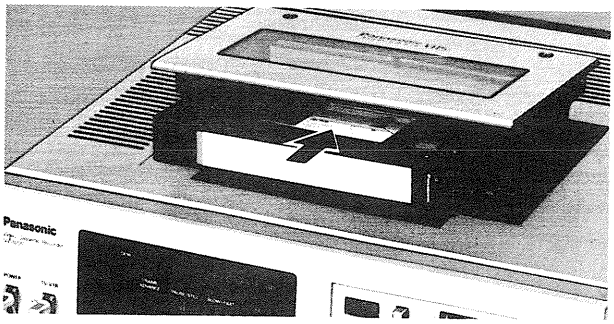
### INSERTION

1. **When power switch is turned to ON, the cassette compartment will raise.**



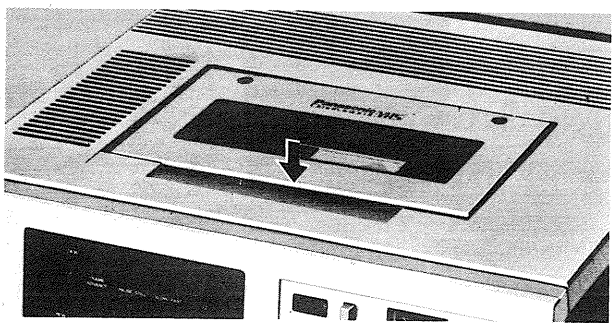
**Note:**
**When power switch is already turned to the "ON" position, push the eject button to raise the cassette compartment.**

2. **When the cassette compartment has fully raised, insert the cassette as far as it will go.**



**Caution:**
**The video cassette can only be used with the window side up, and arrow pointing away from you. Do not attempt to insert a cassette which is upside down or backwards.**

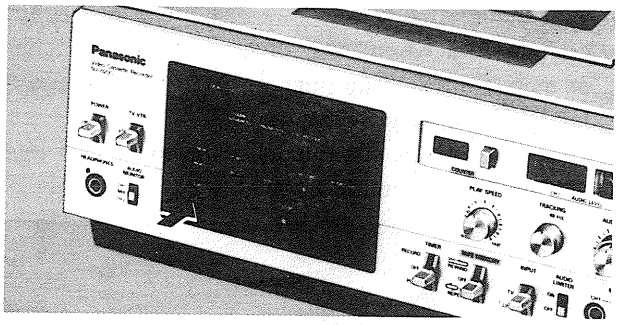
3. **Press the cassette compartment down until it latches.**



**Note:**
When pressing the Cassette Compartment down, be sure to press it at the front edge.

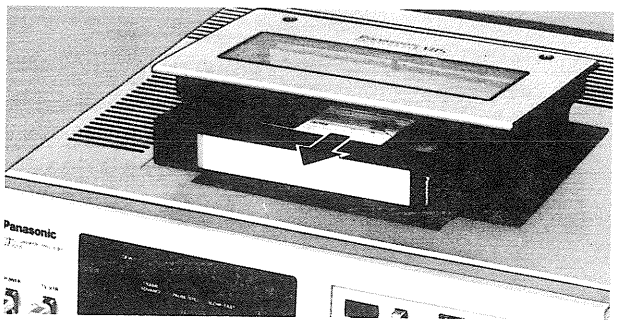
### REMOVAL

1. **Push the eject button to raise the cassette compartment.**

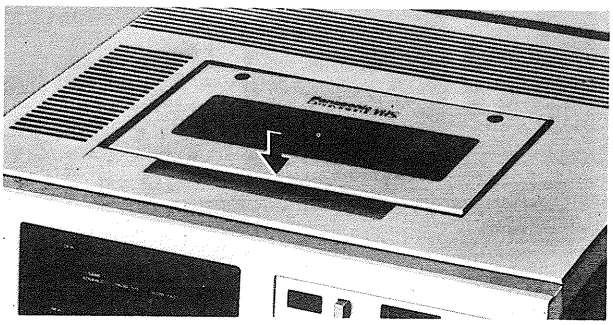


**Note:**
Power must be turned on in order to operate the eject mechanism.

2. **When the cassette compartment has fully raised, remove the cassette.**



3. **Close the empty cassette compartment once again in order to prevent dust and dirt from entering.**

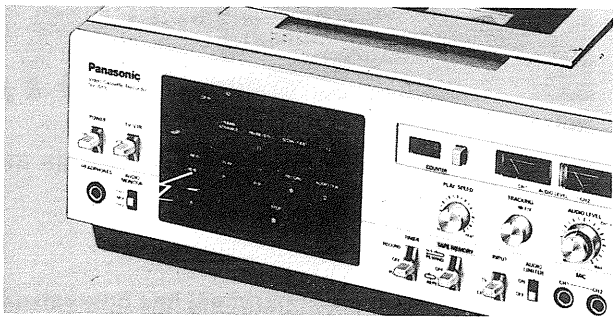


**Note:**
When pressing the Cassette Compartment down, be sure to press it at the front edge.

**REWIND BUTTON [REW]**

Push this button to rewind the tape. The tape will stop automatically when its beginning is reached, or, if desired, when "999" on the counter is reached, or stop it anytime by pushing STOP. (See page 28 for Tape Memory Switch ㉙.)

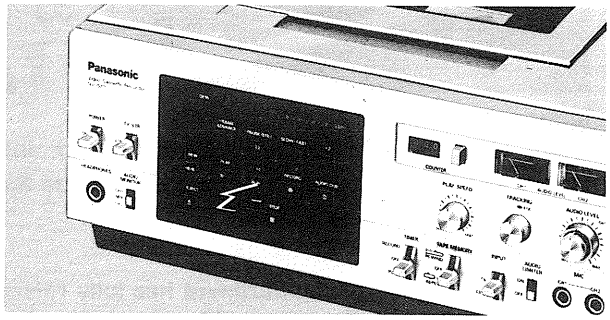
To change from one mode to the next, just push the next mode button directly.




**FAST FORWARD BUTTON [FF]**

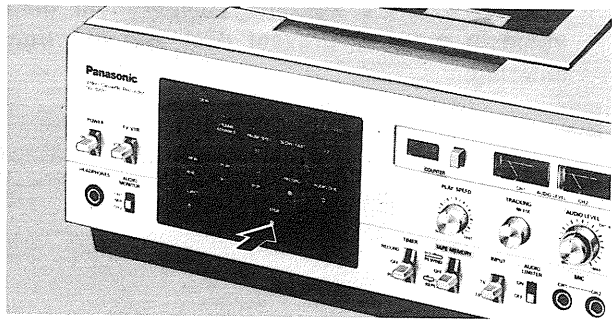
Push this button to quickly advance the tape in the forward direction. When the tape is completely forwarded, it will again be rewound automatically. Stop it anytime by pushing STOP.

To change from one mode to the next, just push the next mode button directly.




**STOP BUTTON [STOP]**

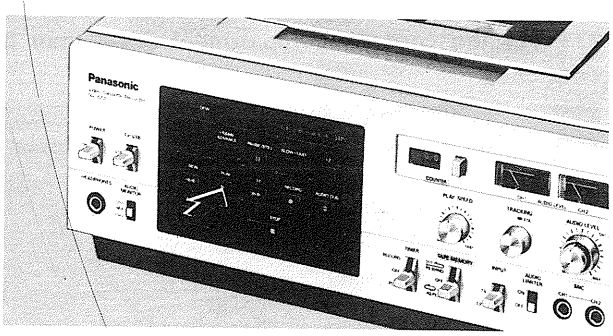
Push this button to stop all other functions.




**PLAY BUTTON [PLAY]**

Push this button to start playback. Playback will automatically stop if the tape reaches its end, and then the tape will be rewound to its beginning and the recorder goes into the stop mode.

To change from one mode to the next, just push the next mode button directly.

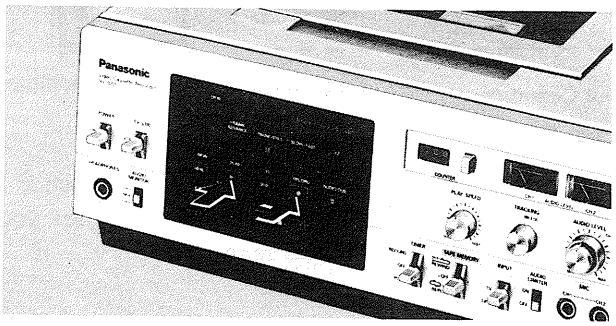


**RECORD BUTTON [RECORD]**

Push this button simultaneously with the Play Button ⑩ to start Video and Audio recording.

Recording will automatically stop if the tape reaches its end, and then the tape will be rewound to its beginning and the recorder goes into the stop mode.

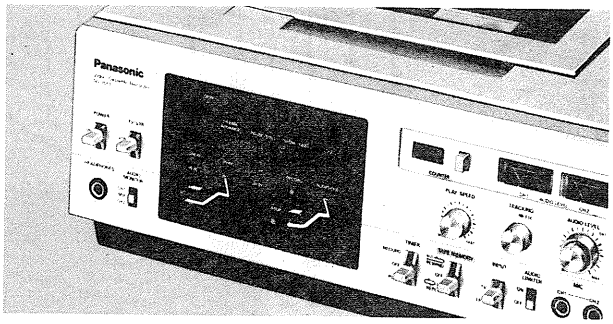
To change from one mode to the next, just push the next mode button directly.




**AUDIO DUBBING BUTTON [AUDIO DUB]**

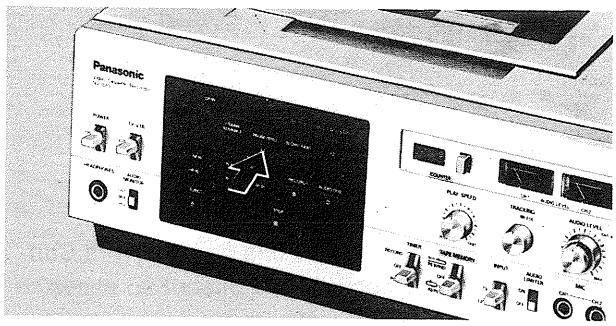
Push both the Play ⑩ and Audio Dub Buttons during playback if it is desired to place a new audio track (Channel 2 only) over a previously recorded tape. This will not affect the video portion. The microphone or audio (line) input must be connected for a dub source. See Audio Dub Section, page 22.

To change from one mode to the next, just push the next mode button directly.




**PAUSE BUTTON [PAUSE/STILL]**

Tape movement can be temporarily stopped during recording or playback by pushing the Pause Button ⑪. (It cannot be used during fast forward or rewind operations.)



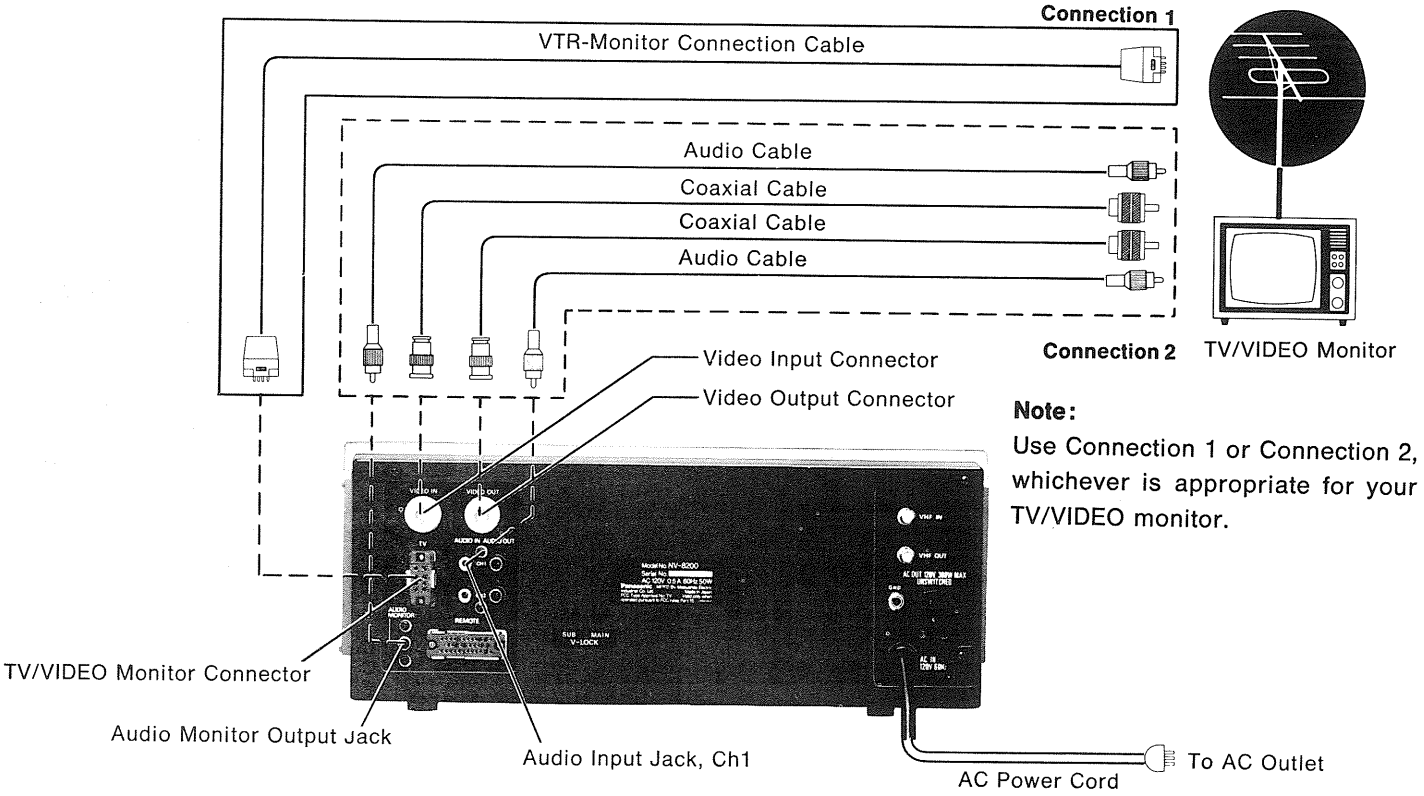

**Notes:**

- The unit will automatically release its pause after approx. 5 minutes, and go into the stop mode, to protect the tape.
- If the tape is paused during playback, a still picture will be produced. Push Pause Button ⑪ again to resume playback.
- It is possible to pause during playback and then immediately start recording.
  To do this, during playback push the Pause Button ⑪ at the point where you want to start recording.
  Then, push the Record Button ⑮ and push the Pause Button ⑪ again.
- The tape can be paused during record to avoid recording commercials, etc.
  Push Pause Button ⑪ again to resume recording.

# USE OF THE NV-8200 WITH A TV/VIDEO MONITOR

## CONNECTION DIAGRAM

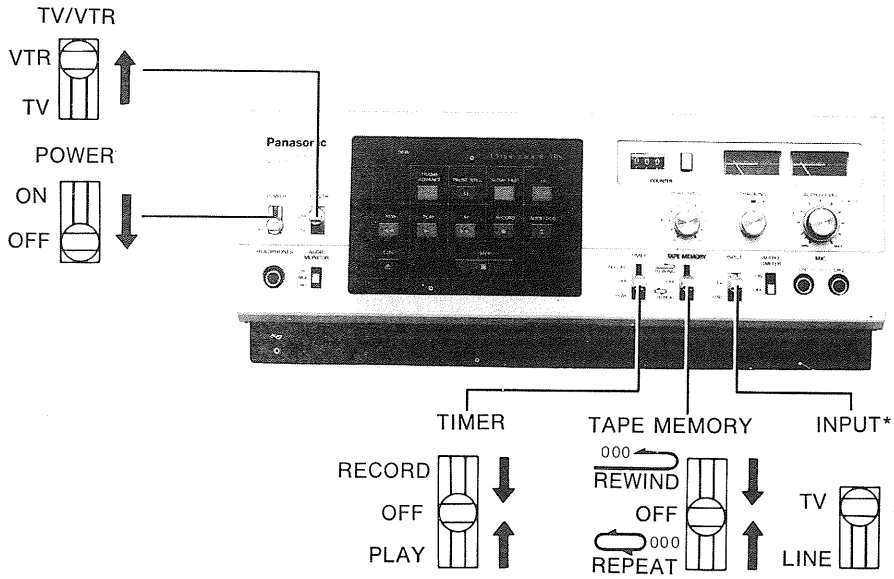
1. Connect the NV-8200 to your TV/VIDEO monitor as described in this section.




**Note:**
Use Connection 1 or Connection 2, whichever is appropriate for your TV/VIDEO monitor.

## OPERATING PROCEDURE

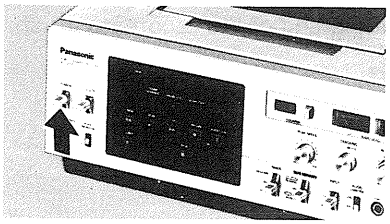
2. After connection, turn power on to the TV/VIDEO monitor and set the switches on the recorder as shown here.
   **Notes:**
   When there is no cassette in the recorder and the power switch is turned on, the Cassette Compartment will automatically raise.




***INPUT**
TV—Use this position with Connection 1 as described above.
LINE—Use the position with Connection 2 as described above.

### 3. Insert the cassette tape

#### (1) Turn power switch to ON

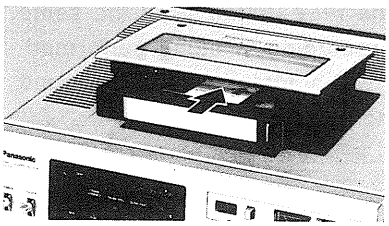


Turn Power Switch ④ to the "ON" position and the Cassette Compartment ① will raise.

**Note:**

Although Power Switch ④ is set to the "ON" position with a cassette tape in the Cassette Compartment ①, the cassette compartment will not raise.

#### (2) Insertion of the cassette tape

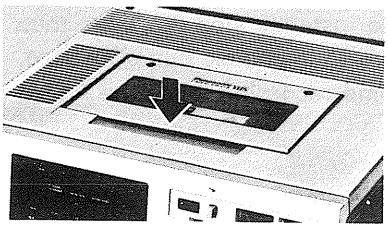


Insert the cassette tape fully into the Cassette Compartment ①.

**Note:**

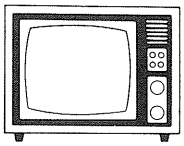
Make sure the tab has not been removed from the back side of the cassette. If the tab has been removed no recording can be made. (See page 3.)

#### (3) Lower the cassette compartment for operation



Press the Cassette Compartment ① down as far as it will go.

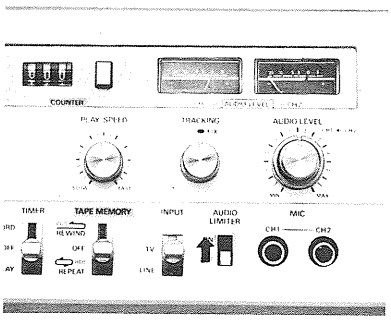
### 4. Tuning of TV/VIDEO monitor



If the TV/VIDEO monitor has an AFT switch, turn it to the "OFF" position.

Adjust the fine tuner as necessary to obtain the best picture. Now turn the AFT switch "ON".

### 5. Adjustment of the audio (CH 1) level




**When connection 1 is used:**

When recording from TV monitor, the audio is recorded on channel 1 only.

Therefore only Audio (ch 1) Recording Level Control ㉓ needs to be adjusted. Adjust so the Audio (ch 1) Level Meter ⑳ rarely indicates beyond 0 dB on peaks.

The indication needle of the Audio Recording Level Meter (Ch 2)㉑ will not move.

**Audio Limiter Selector ㉗**

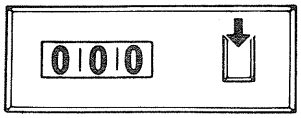
**ON:** To minimize distortion from peak levels set Audio Limiter Selector ㉗ to "ON" position. This permits the average level to be set higher for better signal to noise ratio.

**OFF:** This permits maximum dynamic range to be recorded, but the level must be set low enough so that peaks do not cause objectionable distortion.

**When connection 2 is used:**

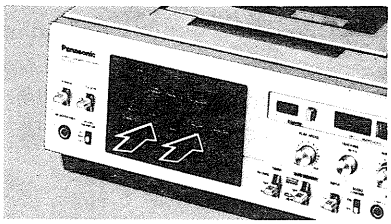
If the Audio Input Jacks ㉟ are used, the audio cable from the monitor TV can be connected to either channel 1 or channel 2, but it is recommended that the connections be made to channel 1 if possible, because only channel 2 can be used for audio dubbing. Operation is the same as described in the section "When connection 1 is used".

### 6. Reset the counter



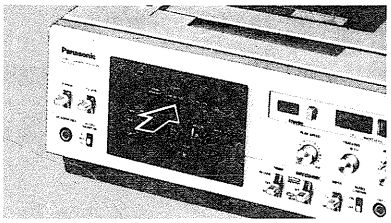

Press the Tape Counter Reset Button ⑲ to reset the counter to "000".
This is done to make finding the beginning of the recording much easier.

### 7. Recording



Push the Record Button ⑮ and the Play Button ⑩ at the same time. Now both audio and video recording is being performed. When the tape reaches its end, it will automatically be rewound to its start by the automatic-rewind system.

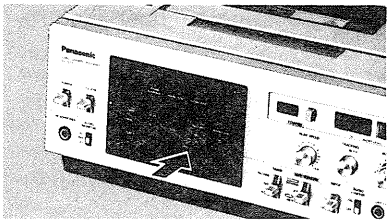
### 8. Pause



During recording, it is possible to instantly stop the tape, thus stopping the recording. To do this, push the Pause Button ⑪ once. Now the tape is stopped. To resume recording, push the Pause Button again.

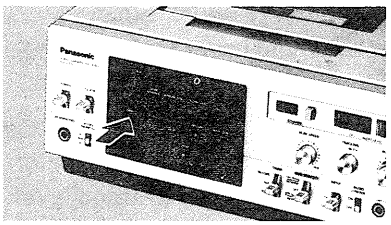
**Note:**
The unit will automatically release its pause after approx. 5 minutes, and go into the stop mode, to protect the tape.

### 9. Stop recording



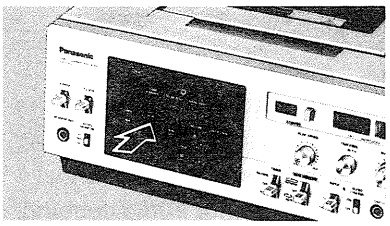
To stop the recording, push the Stop Button ⑭.

### 10. Rewind the tape



To rewind the tape, push the Rewind Button ⑦.
(Refer to page 28 for information concerning automatic rewind and automatic repeat.)

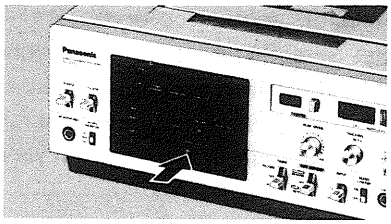
### 11. Playback the tape



Push the Play Button ⑫ to play back a recorded tape on the TV/VIDEO monitor. For a still picture, frame advance, slow-fast motion or double speed picture, see page 27.

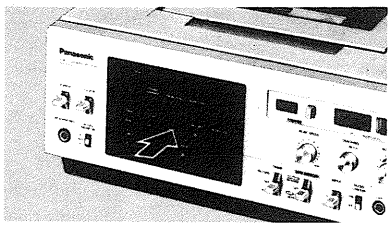
**Note:**
The playback can only be as good as the reception at the time of recording. If there was interference or noise in the original reception, it will be recorded and seen during playback.

**12. Stop playback**



To stop playback, push the Stop Button ⑭.

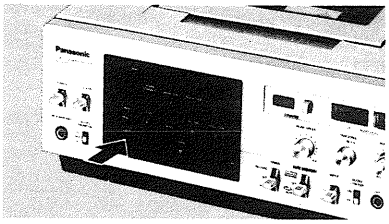
**13. Fast forward the tape**



The Fast Forward Button ⑫ can be used to rapidly advance the tape to the desired portion for playback or recording.

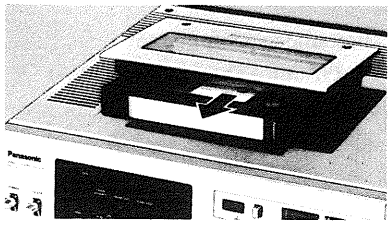
**14. Eject the cassette tape**

**(1) Push the Eject Button**



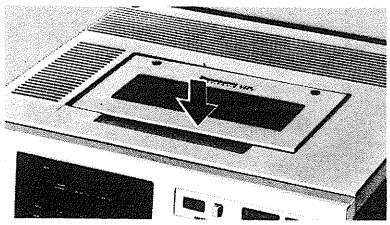
To exchange or remove a video cassette push the Eject Button ⑧ and the Cassette Compartment ① will be elevated for easy removal of the cassette tape.

**(2) Remove the video cassette tape**



After the Cassette Compartment ① has elevated completely, remove the video cassette tape.

**(3) Lower the Cassette Compartment**



Close the empty Cassette Compartment ① once again in order to prevent dust and dirt from entering.

# USING THE NV-8200 WITH A VIDEO CAMERA (Panasonic WV-460)

The NV-8200 may be used with an optional video camera.

The recorder was designed to be used with the Panasonic WV-460 but will also work with most other type video cameras.

With the WV-460 you are able to make Black and White home recordings.

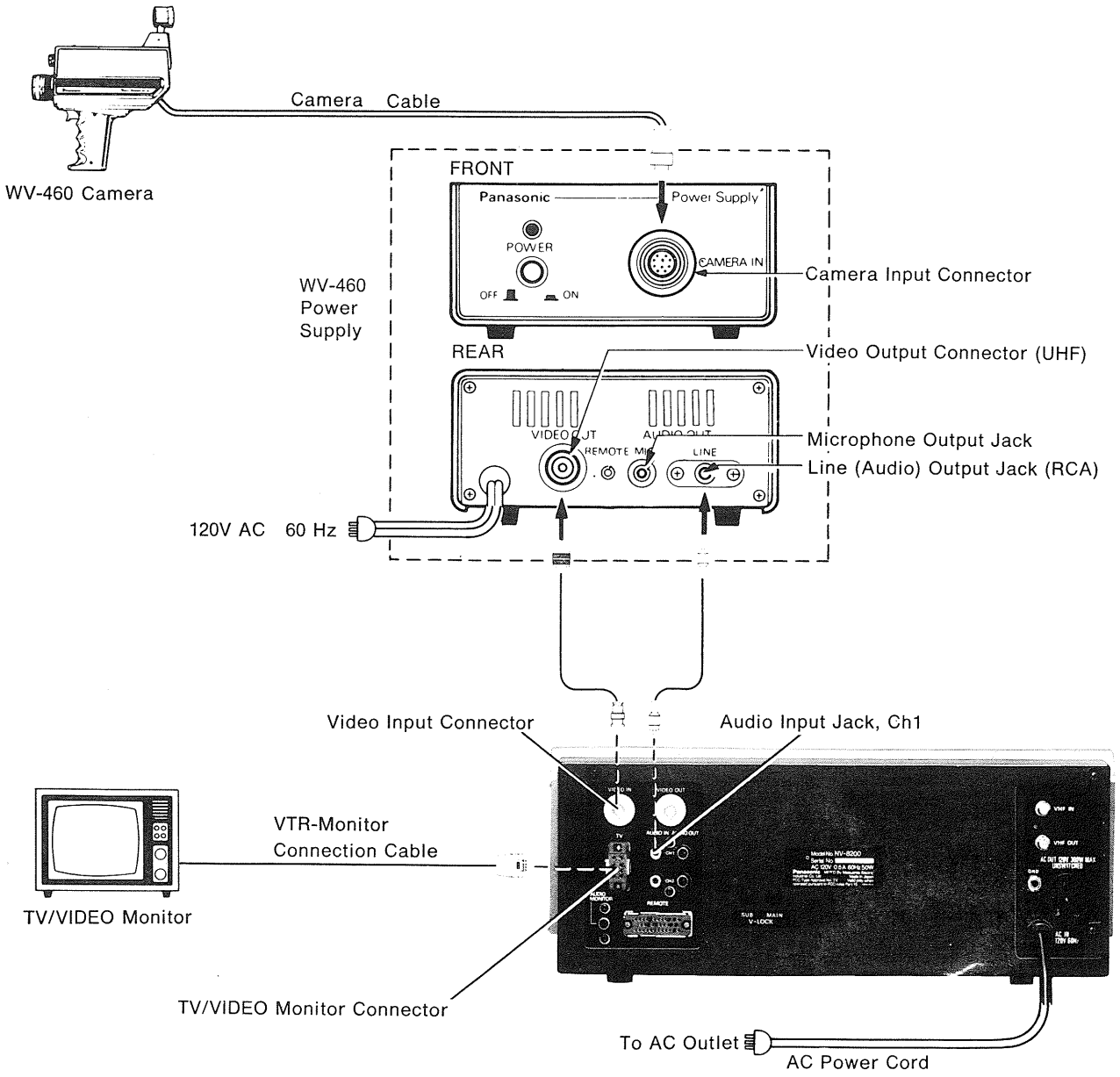
The connection diagrams are shown, but for best results, please refer to the operating instructions of the WV-460 or the camera you are using.

**Notes:**

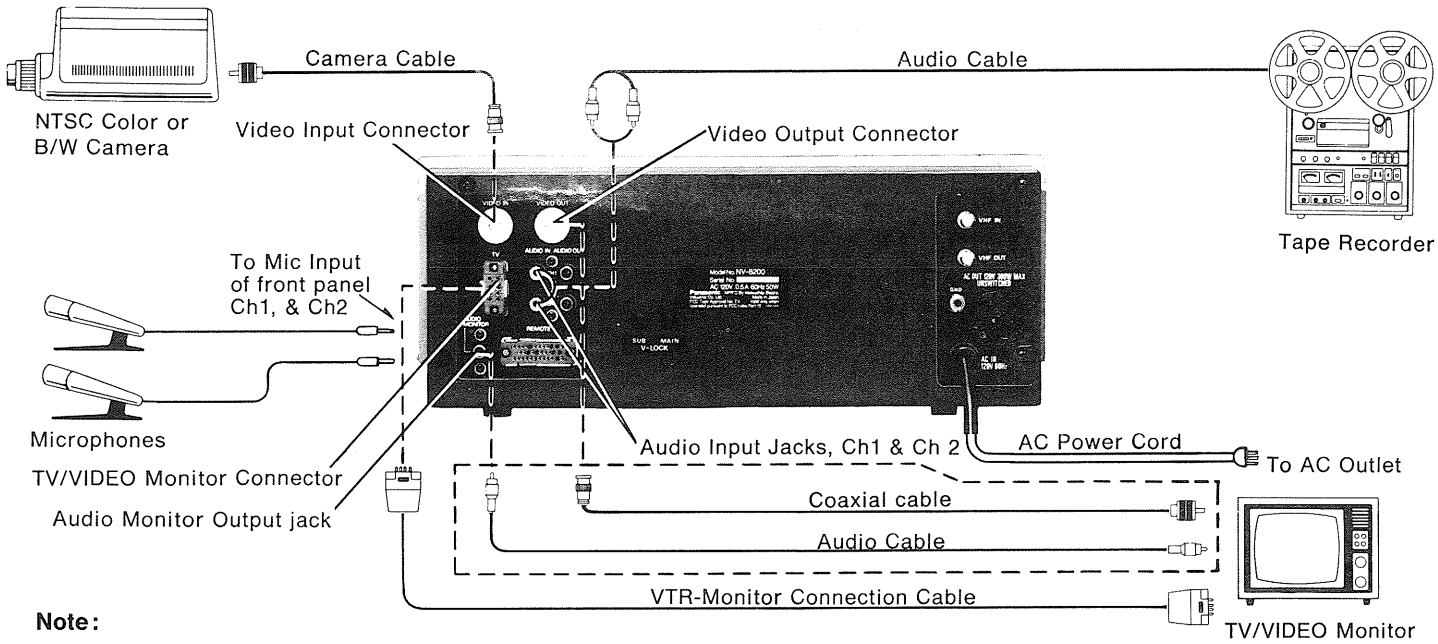
- The TV/VTR Selector ③ must be on "VTR".
- The Input Signal Selector ㉘ must be on "LINE".
- Do not connect both the microphone and audio (line) inputs to the recorder to the same channel. If this is done, just the microphone will be recorded.

## CONNECTION DIAGRAMS

### 1. Using the NV-8200 with the Panasonic WV-460



**2. Using the NV-8200 with another type video camera**



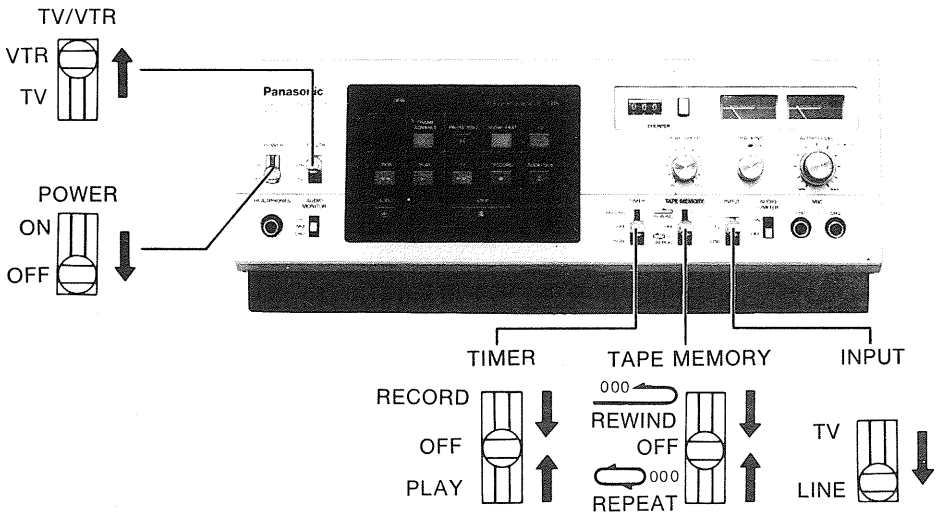

**Note:**

Do not connect both the microphone and audio (line) inputs to the recorder at the same time. If this is done, just the microphone will be recorded.

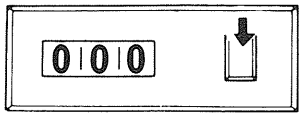
**Set the switches on the recorder as shown here.**

**Note:**

When there is no cassette in the recorder and the power switch is turned ON, the Cassette Compartment will automatically raise.




1. **Connect the camera, and the TV to the recorder as shown in the connection diagram.**
2. **Set each switch on the recorder as shown above.**
3. **Turn the power switch of the camera and TV to "ON".**
4. **Insert a cassette tape according to the procedure on page 8.**
5. **Adjust the audio (CH1) and/or audio (CH2) recording level.**
6. **Reset the counter.**




Press the Tape Counter Reset Button ⑲ to reset the counter to "000". This is done to make finding the beginning of the recording much easier.

7. **Perform RECORDING, PLAYBACK, PAUSE, REW, FF, AUDIO DUB and STOP as desired according to the Basic Operation section, page 9.**
8. **The signal being recorded can be monitored during recording by viewing the TV set.**

# PLAYBACK WITH A TV SET

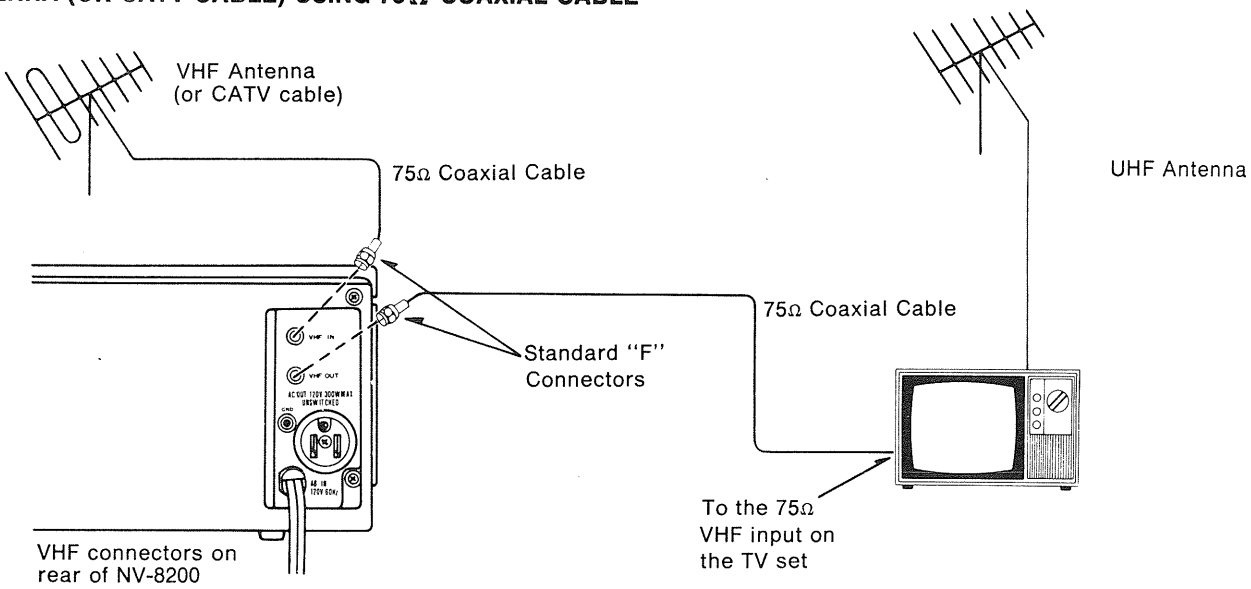
The NV-8200 recorder's connection and use with an antenna (or CATV cable) and a TV set are very simple, and should be permanent.
Normally, the UHF antenna is connected directly to the TV set.

When the recorder is used, the VHF antenna (or CATV cable) is connected directly to the recorder. The VHF antenna signal then comes out of the recorder and is delivered to the TV set.

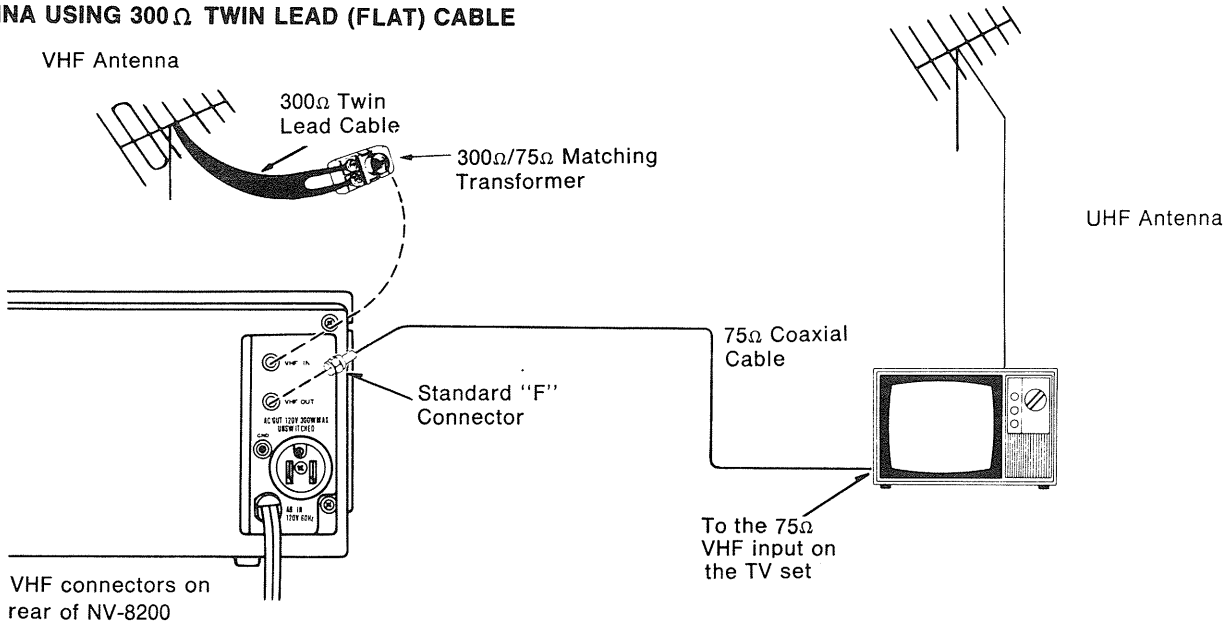
## CONNECTION DIAGRAMS

**CONNECT THE NV-8200 TO YOUR VHF ANTENNA AS DESCRIBED IN THIS SECTION.**

### ■ VHF ANTENNA (OR CATV CABLE) USING 75Ω COAXIAL CABLE



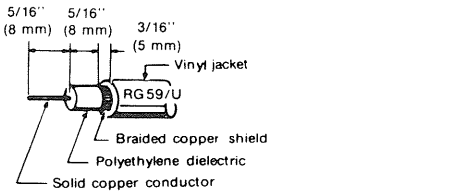

### ■ VHF ANTENNA USING 300Ω TWIN LEAD (FLAT) CABLE



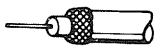

In this case where the VHF antenna uses 300Ω twin lead (flat) cable, the matching transformer must be connected as shown to match the antenna to the recorder.

**Note:**
If your 75 ohm coaxial cable does not use an "F" type connector, you can install one yourself by using the included "F" connector and the following instructions.

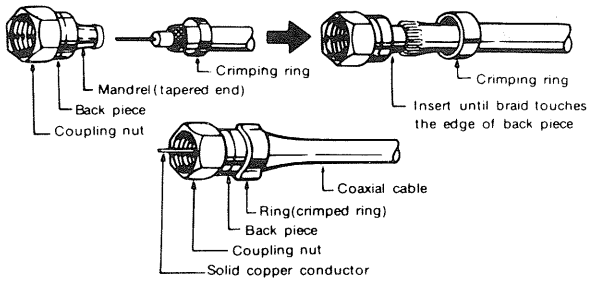
**How to attach a male "F" connector to RG59/U type coaxial cable with braided copper shield.**




**Step 1**



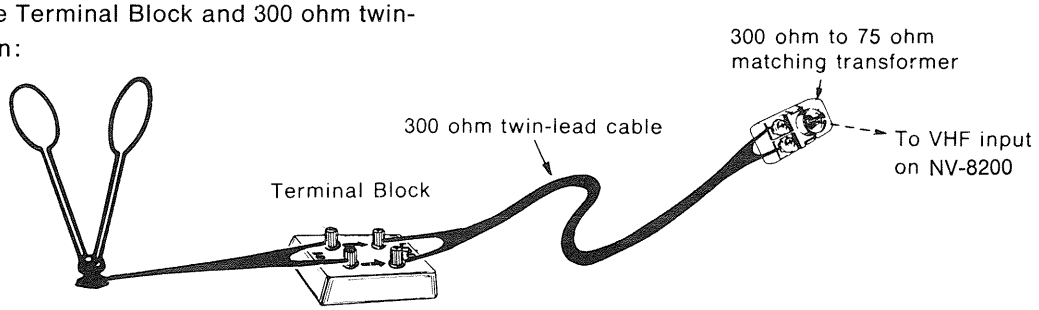
**Step 2**



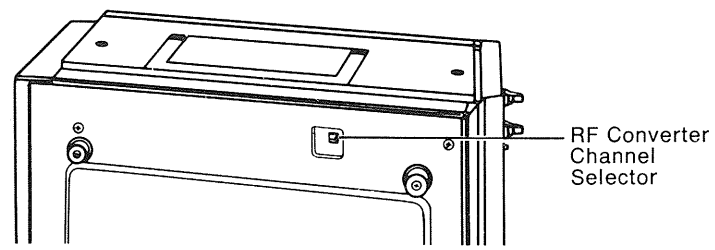

**Step 3**

1. Prepare the end of coaxial cable as shown in step 1.
   **Note:**
   The lengths of solid copper conductor, polyethylene dielectric and braid shield should be measured and cut carefully.
2. Fold back the copper braid shield over the outer jacket, next, trim off the shield close to outer jacket as shown in step 2.
3. Slide the crimping ring supplied with "F" connector over the cable as shown in step 3.
4. Place connector on cable inserting the mandrel (tapered end) of "F" connector between the braid shield and the dielectric material of coaxial cable, forcing it in until the braid is touching the back piece of connector (step 3).
   Move the crimping ring up to the back piece of the connector and crimp the ring securely with pliers.
   **Notes:**
   (1) The bare solid copper conductor extend at least 1/8" (3.17 mm) beyond front of connector.
   (2) Make sure after crimping the ring that the connector cannot be pulled out of the coaxial cable.

**Note:**
If you use rabbit ears type of antenna at your TV set, the lead may not be long enough to attach to the recorder. In this case, use the Terminal Block and 300 ohm twin-lead cable as shown:




## ■ RF CONVERTER

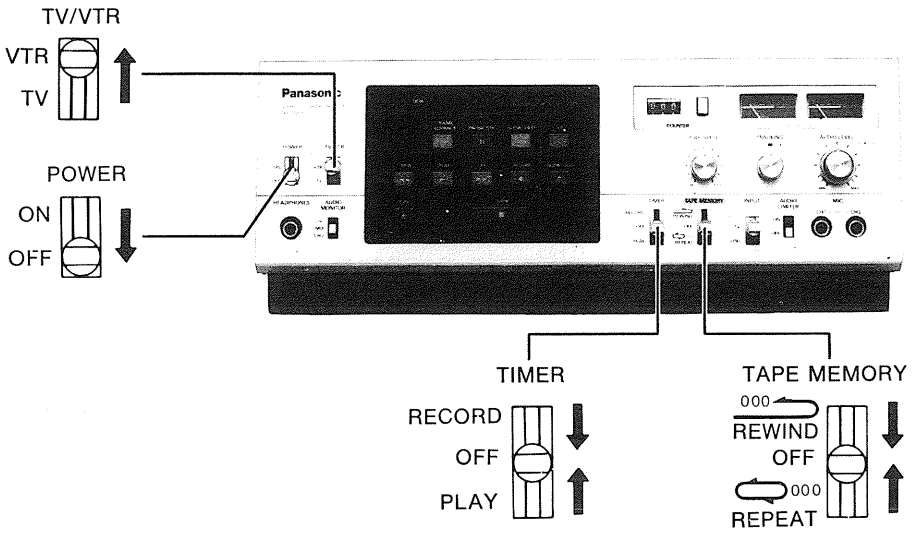



Bottom view of NV-8200

The RF converter inside the recorder modulates the playback video signal up to Channel 3 or Channel 4, as selected by the RF Converter Channel Selector on the bottom side of the recorder. Move the switch to CH3 or CH4 (use a small screwdriver) whichever channel is not broadcast in your location. Remember, your TV set must be tuned to the same channel as selected at the recorder.

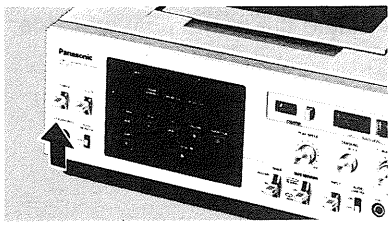
## OPERATING PROCEDURE

1. **Connect the VHF antenna, and the TV to the recorder as shown in the connection diagrams. See page 17.**
2. **After connection, turn power on to the TV receiver and set its channel selector to the same channel as the RF converter.**
   **Also set the switches on the recorder as shown here.**
   **Note:**
   When there is no cassette in the recorder and the power switch is turned ON, the Cassette Compartment will automatically raise.




**3. Insert the cassette tape**

**(1) Turn power switch to ON**

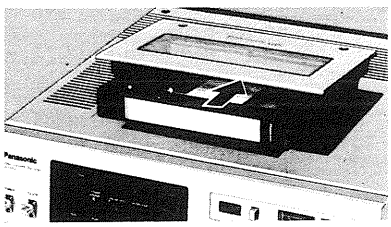


Turn Power Switch ④ to the "ON" position and the Cassette Compartment ① will raise.

**Note:**

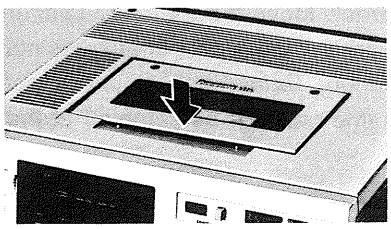
Although Power Switch ④ is set to the "ON" position with a cassette tape in the Cassette Compartment ①, the cassette compartment will not raise.

**(2) Insertion of the cassette tape**



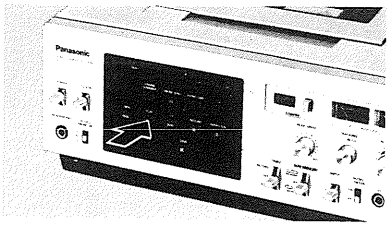
Insert the cassette tape fully into the Cassette Compartment ①.

**(3) Lower the cassette compartment for operation**



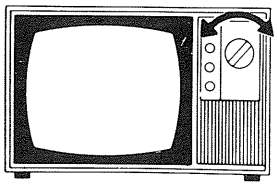
Press the Cassette Compartment ① down as far as it will go.

### 4. Playback the tape



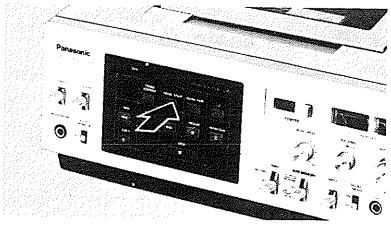
Push the Play Button ⑩ to play back a recorded tape on the TV.
For a still picture, frame advance, slow-fast motion or double speed picture, see page 27.

### 5. Tuning of the TV



If the TV has an AFT switch, turn it to the "OFF" position. Adjust its fine tuner as necessary to obtain the best picture.
Now turn the AFT switch "ON".

### 6. Pause

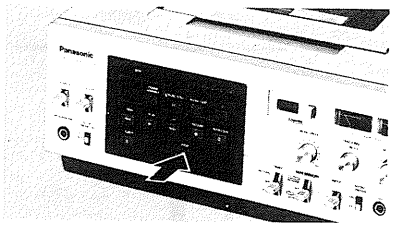


During playback, when the Pause Button ⑪ is pushed, the tape stops, and a still picture appears. The unit will automatically adjust itself for a clean still picture and then hold.

**Note:**

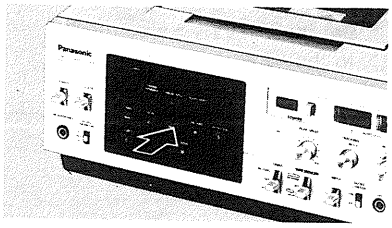
The unit will automatically release its pause after approx. 5 minutes, and go into the stop mode, to protect the tape.

### 7. Stop playback



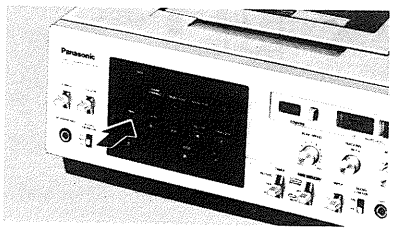
To stop playback, push the Stop Button ⑭.

### 8. Fast forward the tape



The Fast Forward Button ⑫ can be used to rapidly advance the tape to the desired portion for playback.

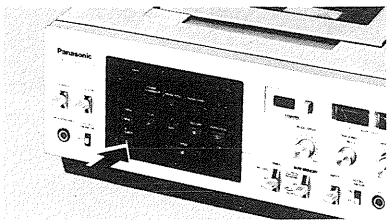
### 9. Rewind the tape



To rewind the tape, push the Rewind Button ⑦.
(Refer to page 28 for information concerning automatic rewind and automatic repeat.)

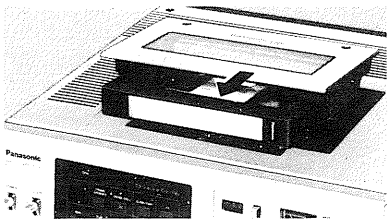
**10. Eject the cassette tape**

**(1) Push the Eject Button**



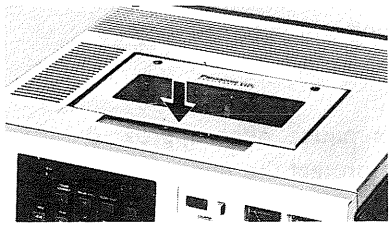
To exchange or remove a video cassette push the Eject Button ⑧ and the Cassette Compartment ① will raise for easy removal of the cassette tape.

**(2) Remove the video cassette tape**



After the Cassette Compartment ① has elevated completely, remove the video cassette tape.

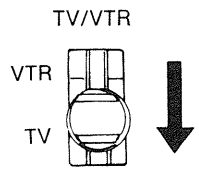
**(3) Lower the Cassette Compartment**



Close the empty Cassette Compartment ① once again in order to prevent dust and dirt from entering.

## WATCHING REGULAR TV BROADCASTS

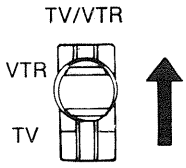
If after connecting the NV-8200 to your VHF antenna, it is desired to view a regular TV broadcast on your TV, set the TV/VTR Selector ③ to the "TV" position. Now use your TV as you normally would. The recorder does not have to be turned ON.




Set the TV/VTR Selector ③ to the "TV" position.

## WATCHING THE PLAYBACK SIGNALS OF THE NV-8200

To view the playback signal of the NV-8200 on your TV set, place the TV/VTR Selector ③ to the "VTR" position. With the TV/VTR Selector ③ in the "VTR" position, the TV must be tuned to the same channel as the RF converter.
(See Operating Procedure, pages 19, 20.)

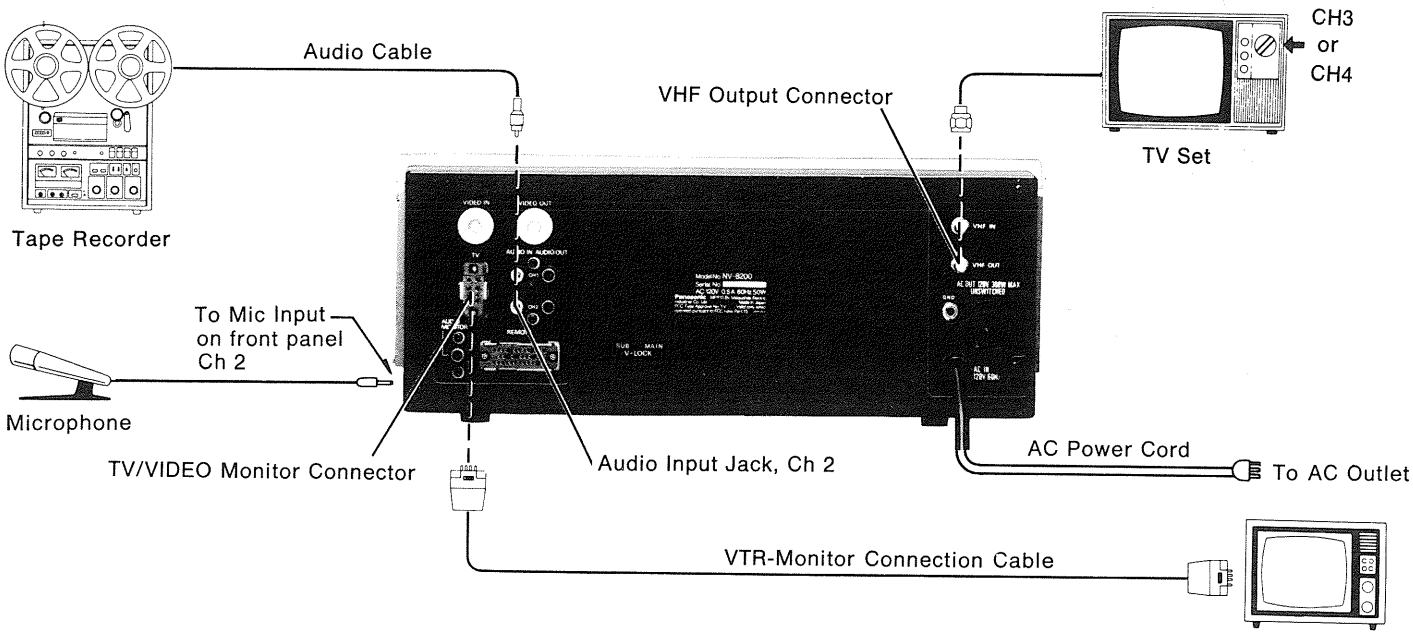



Set the TV/VTR Selector ③ to the "VTR" position.

# AUDIO DUBBING

Audio dubbing allows an audio Channel 2 recording to be made on a pre-recorded tape.
In this way, pre-recorded video and audio Channel 1 will not be disturbed.

## CONNECTION DIAGRAM

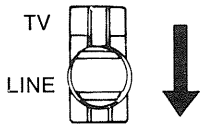



**Notes:**

- Audio dubbing can be made on audio Ch 2 only.
  Although channel 2 sound can be heard from channel 1 during audio dubbing (if the sound is monitored), no recording will be made on audio channel 1.
- Avoid having a microphone connected to the Mic Input Jack ㉖ on the front panel at the same time that an audio signal is connected to the Audio Input Jack ㉟.
  If this happens, just the microphone will be recorded.
- If the tab is removed from the back side of the video cassette, no audio dubbing can be made.
- If using the microphone for dubbing, do not get it near the speaker on the TV while the dub is being made.
  A howling noise (feedback) may occur.
- No audio dubbing can be made even when VTR-monitor connection cable is used.

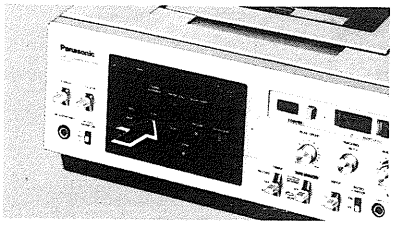
**1. Connect the recorder as shown above.**

**2. Set the Input Signal Selector**



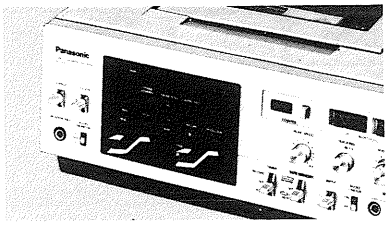

Set the Input Signal Selector ㉘ to the "LINE" position, if it is desired to record from a signal applied to the Audio (Line) Input Jack ㉟.

**3. Push the Play Button**



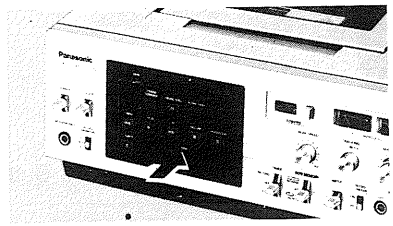
Playback the tape onto which you want to place the audio dubbing.

**4. Push the Play and Audio Dub Button at any desired part**



When it is desired to start the audio dub push the Play ⑩ and Audio Dub ⑰ Buttons at the same time.
Now only the new audio is being recorded onto the tape. The video will remain unchanged, and can be viewed on the TV as the audio dub is being made.

**5. Stop audio dubbing**

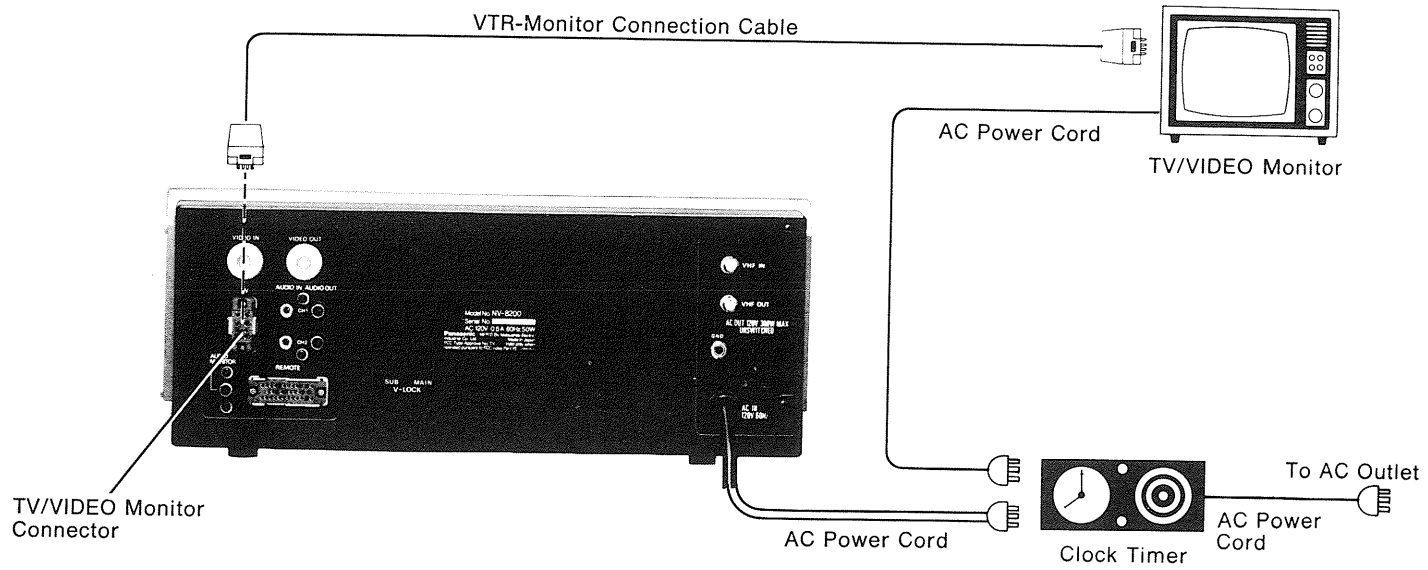


Push the Stop Button ⑭. The audio dubbing will stop.

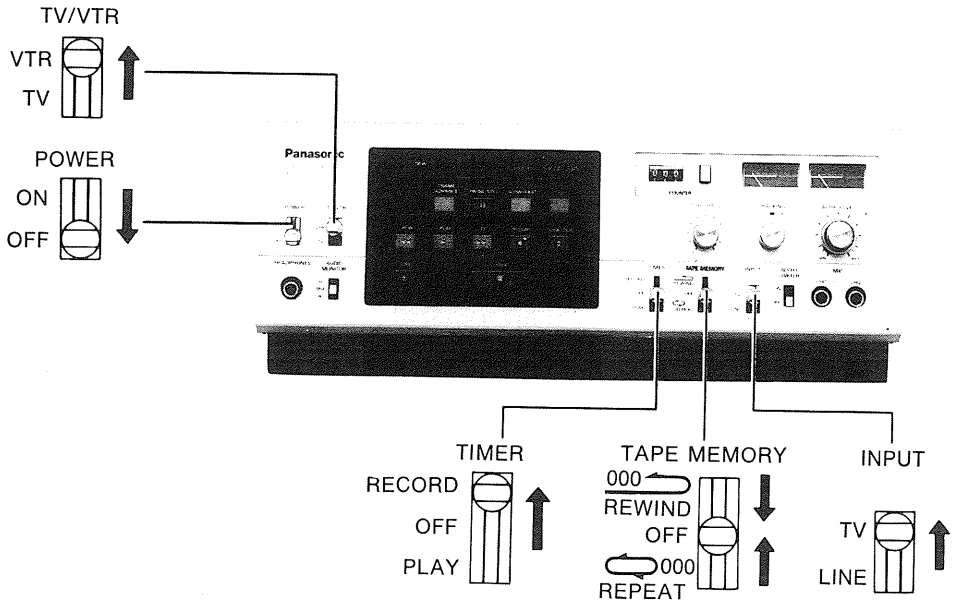
**Note:**
If you want to check the audio signal before making a dub, you can do so by pushing the Audio Dub Button ⑰ only. Now you can hear on your TV the signal from the microphone or other source.

# HOW TO RECORD TV PROGRAMS BY USING A CLOCK TIMER

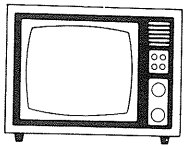
## CONNECTION DIAGRAM




**Set the switches on the recorder as shown here.**

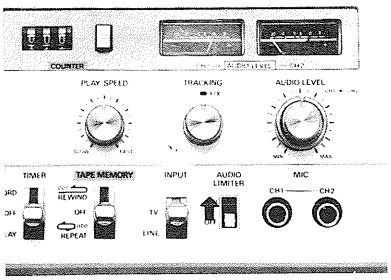



1. **Connect the TV/VIDEO monitor to the recorder as shown above.**
2. **Connect AC power cord of the timer to AC outlet.**
3. **Set timer at desired time (Refer to the operating instructions for the timer. The timer should be purchased locally).**
4. **Set each switch on the recorder as shown above.**
5. **Insert a cassette tape according to the procedure on page 8.**
6. **Tuning of TV/VIDEO monitor.**



If the TV/VIDEO monitor has an AFT switch, turn it to the "OFF" position.
Adjust its fine tuner as necessary to obtain the best picture.
Now turn the AFT switch "ON".

### 7. Adjustment of the audio (CH 1) level




Adjust Audio (ch 1) Recording Level Control ㉓ so the Audio (Ch 1) Level Meter ⑳ rarely indicates beyond 0 dB on peaks.

**Audio Limiter Selector ㉗**

**ON:** To minimize distortion from peak levels set Audio Limiter Selector ㉗ to "ON" position. This permits the average level to be set higher for better signal to noise ratio.

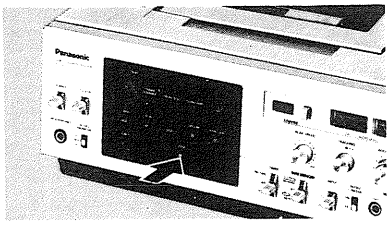
**OFF:** This permits maximum dynamic range to be recorded, but the level must be set low enough so that peaks do not cause objectionable distortion.

### 8. Recording at the pre-set time

At the pre-set time, the power will be automatically turned on and the tape starts moving in the recording mode. When the tape reaches its end, it will automatically be rewound to its beginning and will then stop automatically.

**Notes:**

■ **Stop timer recording**

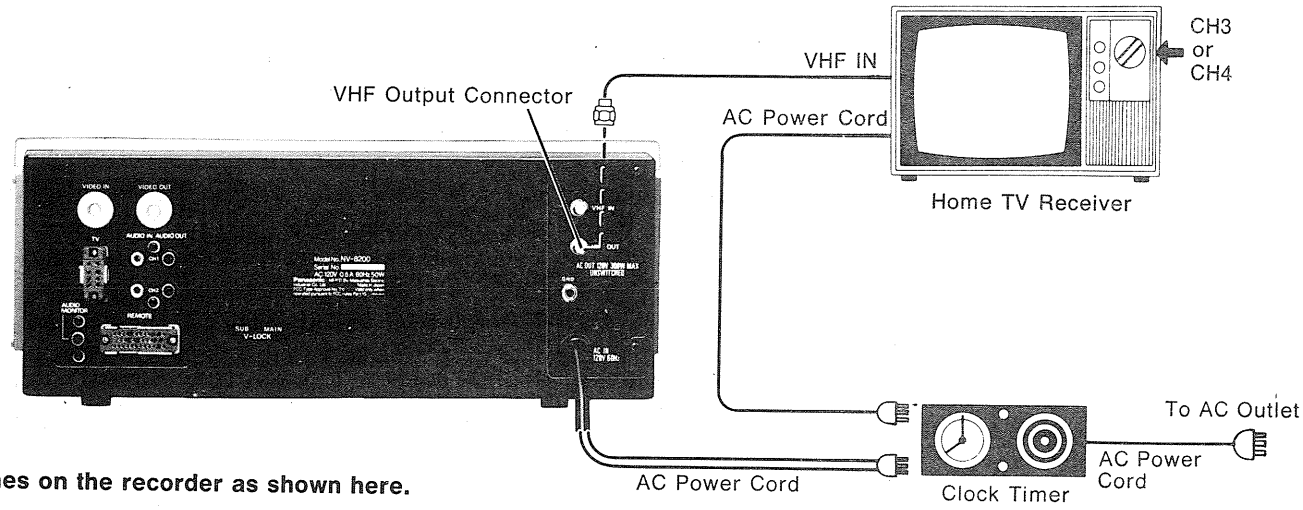


The tape can be stopped before it reaches its end, if desired, by pushing the Stop Button ⑭.

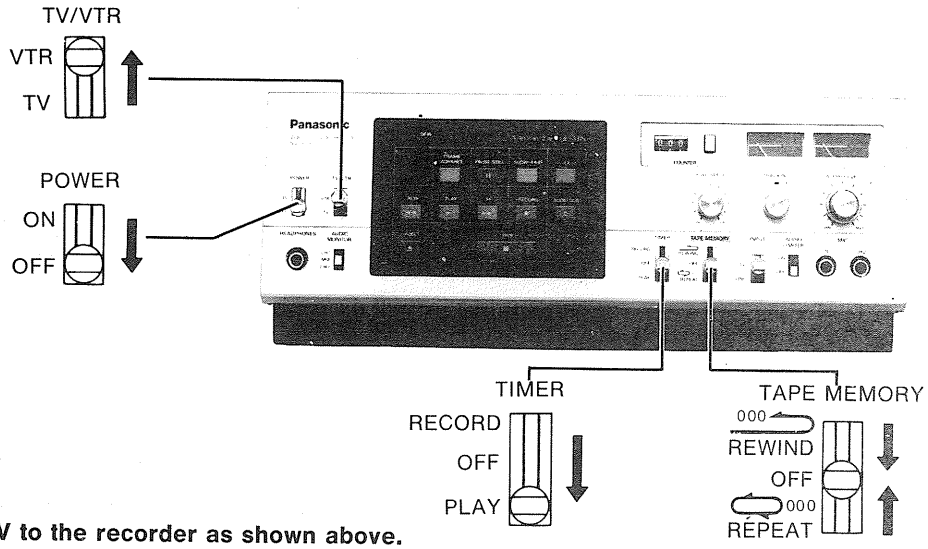
- ■ Be certain the Power Switches of this unit and TV are on.
- ■ If the power is for any reason interrupted while making a timer recording, the recording won't continue even if the power is subsequently resumed.
- ■ The timer used should be the type which has power turn-off after the timer recording has finished.
- ■ Continuous recordings cannot be made by using the timer.
- ■ Avoid timer recordings while the Auto Search Controller (optional) remains connected.
- ■ The power will be turned off while the tape is moving, during timer recording, when the timer turn-off time is reached; but the tape will remain loaded in the cylinder of this unit. To protect the tape, therefore, be sure to set the timer to turn off at a time which is about 10 minutes after the tape will end. If, for example, NV-T120 tape is used, the turn-off time should be about 130 minutes after recording starts.

# HOW TO PLAYBACK BY USING A CLOCK TIMER

## CONNECTION DIAGRAM




**Set the switches on the recorder as shown here.**




1. **Connect the TV to the recorder as shown above.**
2. **Connect AC power cord of the timer to AC outlet.**
3. **Set the timer so it provides power at desired time. (Refer to the operating instructions for the timer. The timer should be purchased locally.)**
4. **Set each switch on the recorder as shown above.**
5. **Insert a recorded video cassette tape according to the procedure on page 8.**
6. **Playback at the pre-set time.**

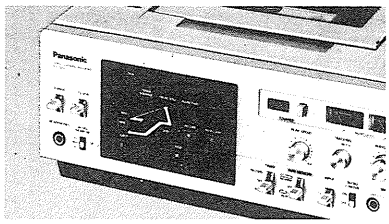
   At the pre-set time, the timer will provide power to both TV and VTR, and playback will begin. When the tape reaches its end, it will automatically be rewound to its beginning and will then stop automatically.

**Notes:**

- Timer playback can be stopped before it reaches its end, if desired, by pushing the Stop Button ⑭. Be certain the Power Switches of this unit and TV are on.
- If during timer playback the power is cut off, timer playback operation will not resume when the power is restored. In this case, to resume playback, manually push the Play Button ⑩ after the power is restored.
- Tape memory switch will also function during timer operation if so desired.
- The timer used should be the type which has power turn-off after the timer playback has finished.
- Continuous playback cannot be made by using the timer.
- Avoid timer playback while the Auto Search Controller (optional) remains connected.
- The power will be turned off while the tape is moving, during timer playback, when the timer turn-off time is reached; but the tape will remain loaded in the cylinder of this unit. To protect the tape, therefore, be sure to set the timer to turn off at a time which is about 10 minutes after the tape will end. If, for example, NV-T120 tape is used, the turn-off time should be about 130 minutes after playback starts.

# DESCRIPTION OF PAUSE AND PLAYBACK OPERATIONS

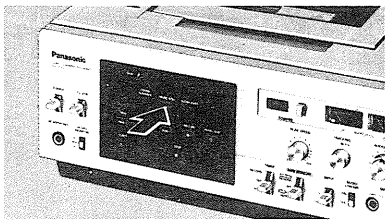
## USING PAUSE DURING RECORD



During recording, the Pause Button ⑪ may be pushed to instantly stop the recording in order to avoid recording unwanted material, commercial material, etc.
Push the Pause Button again to release pause. If not, the unit will automatically release its pause after approx. 5 minutes, and go into the stop mode, to protect the tape.

## STILL PICTURE, FRAME-BY-FRAME ADVANCE, SLOW-FAST MOTION AND DOUBLE SPEED

### ■ STILL PICTURE

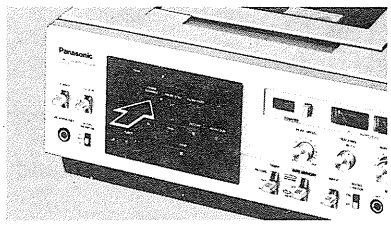


During playback, when the Pause Button ⑪ is pushed, the tape stops, and a still picture appears. The unit will automatically adjust itself for a clean still picture and then hold.

**Notes:**

- Depending upon the type of TV set connected with this set, vertical "jitter" of still pictures may occur. This can be corrected by using Vertical Lock Adjusters Sub ㊳ and Main ㊴, located on the rear panel of this unit.
  (Refer to page 6, "OPERATING COMPONENTS AND THEIR FUNCTIONS".)
- If the Pause Button ⑪ is pushed during audio dubbing, "noise" will be seen in the still picture, but this is not a malfunction.

### ■ FRAME ADVANCE

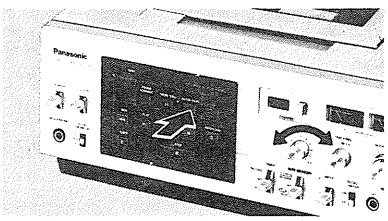


When viewing a still picture, a frame-by-frame advance can be obtained by pushing the One-Shot Frame Advance Button ⑨.

**Note:**

The still picture may appear to vibrate at portions where a normal picture indicates fast motion.

### ■ SLOW-FAST MOTION



To obtain a slow-fast motion playback picture, push the Slow-Fast Button ⑬.
The slow-fast motion speed can be varied from 1/5 to 1.5 times normal by adjusting the Play Speed Control ㉒.

### ■ DOUBLE SPEED

When the Double Speed Button ⑯ is pushed, a double speed playback picture will appear on the screen.

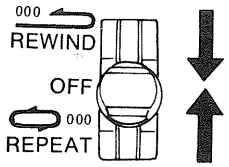
**Note:**

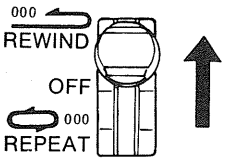
In some cases, a noise bar may appear on the screen. If this happens, turn the Tracking Control ㉕ slowly until the best picture is obtained.

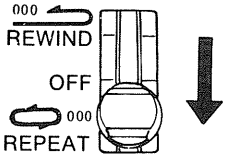
During double-speed playback, the audio will also be played back at double speed, and the sound will be practically unintelligible.

# DESCRIPTION OF SPECIAL FUNCTIONS

## HOW TO USE THE TAPE MEMORY SWITCH




The tape memory switch can be used to automatically stop tape rewinding at the place where the tape counter digits read "999", or repeat the playback between the beginning of the tape and the place where the tape counter digits read "000".

- **OFF**

For normal operation, set the Tape Memory Switch ㉙ to "OFF".

- **REWIND**

If there is a place during recording or playback at which you want to start playback once again, press the Tape Counter Reset Button ⑲ to set it to "000" and set to the "REWIND" position. Then, when the tape is rewound by pushing the Rewind Button ⑦ after playback has finished, the tape will stop when it reaches this designated position (999). The tape can then be played back.

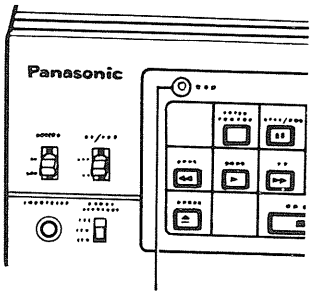
- **REPEAT**

If it is desired to watch the program repeatedly, set the Tape Memory Switch ㉙ to the "REPEAT" position. Press the Tape Counter Reset Button ⑲ to "000" at the last point of the program where you want to repeat playback automatically.
Then push the Rewind Button ⑦. The tape will then automatically repeat.

**Note:**

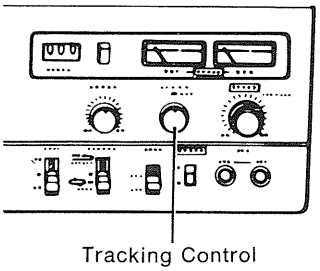
When the Repeat Playback system is used, the Tape Counter ⑱ may vary from the "000" position by ±5~8 seconds for each repeat playback. It is recommended, therefore, that a check be made occasionally if repeat playback operation is to be continued for a long period of time.

## DEW DETECTOR




If the recorder has been stored in a very cool place for some time and is then used in a warm environment, there exists the possibility of condensation forming on parts of the recorder. Moisture inside the recorder or on the tape can be very harmful.
To help guard against any moisture damage, the recorder utilizes a dew sensor.
If any condensation occurs, the recorder will not operate and the Dew Lamp ② will come on. If this happens, leave the recorder on and let it remain at room temperature until the Dew Lamp ② no longer lights. Then proceed with operation.

## HOW TO USE THE TRACKING CONTROL



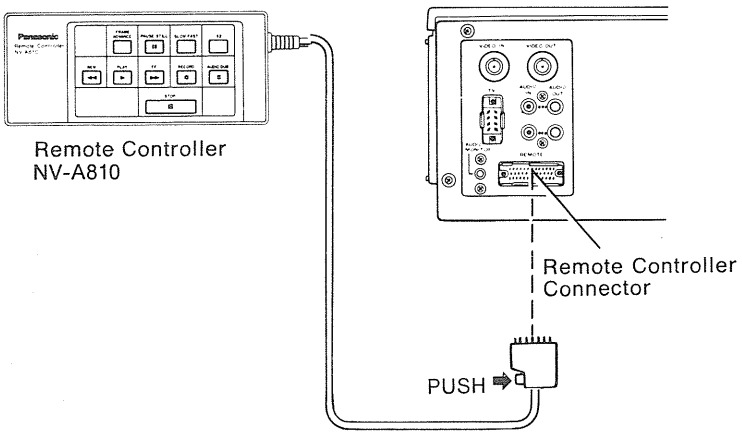

The Tracking Control ㉕ is normally left in the "FIX" position. If a particular playback picture becomes very noisy or streaked, turn the Tracking Control ㉕ slowly in either direction until the picture is again clear. It is recommended to place the Tracking Control ㉕ back into the "FIX" position when playback of that particular tape is finished.

Good Picture

Noisy Picture

# USING THE OPTIONAL ACCESSORIES

## ■ USING THE REMOTE CONTROLLER NV-A810

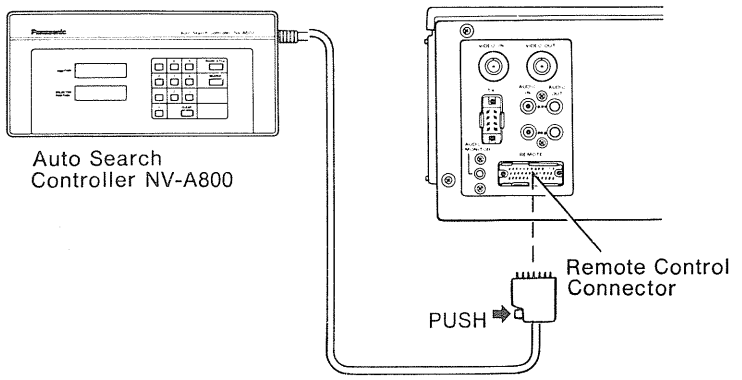



If the optional remote controller NV-A810 is connected to the Remote Control Connector ㊱, record, playback, fast forward, rewind, audio dub, stop, pause, one-shot frame advance, slow-fast motion and double speed playback modes can be performed from a distance. This controller functions in the same manner as the push-buttons on the unit.

**Notes:**

- Pause must be pushed once again to release pause.
- The controls on the recorder can still be used even when the NV-A810 is connected.
- When the recorder is paused during a recording, the exact point of the pause may produce a momentary disturbance of the picture during playback. This effect, if it occurs, is normal.

## ■ USING THE AUTO SEARCH CONTROLLER NV-A800

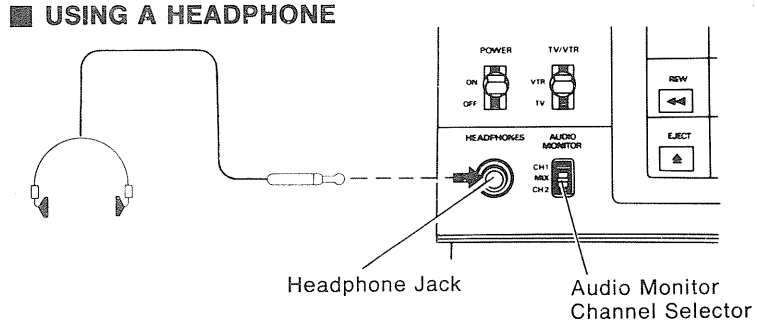



If the optional auto search controller NV-A800 is connected to the Remote Control Connector ㊱, you can easily find the desired program during playback. By pushing the numerical buttons, select the spot of the program you want to play back. Then push the search/play button and playback will automaticaly commence from the point you have selected. For details, read the Operating Instructions of the NV-A800.

**Notes:**

- If the auto search controller is used, check to be sure that the Timer ㉚ and Tape Memory ㉙ Switches are in the "OFF" position.
- If the auto search controller is used too close to the TV set used for tape playback and the TV power is turned on or off, the operation may not be normal.

## ■ USING A HEADPHONE




Insert the headphone plug into the Headphone Jack ⑥. The headphone permits listening to audio Channel 1 or Channel 2 or both Channels in stereo by setting the Audio Output Channel Selector ⑤.

### FUNCTIONAL CHART FOR AUDIO

| Setting of Audio Monitor Channel Selector ⑤ | Audio Monitor Output Jack ㉞ | Headphone Jack ⑥ | Audio Output Jacks Channel 1 Channel 2 ㊲ |
|---|---|---|---|
| CH1 | Audio from channel 1 only | Audio from channel 1 only | Both audio signals not affected by selector setting |
| MIX | Sound from both channels will be mixed | (Not mixed) STEREO Channel 1...Left Channel 2...Right | |
| CH2 | Audio from channel 2 only | Audio from channel 2 only | |

## ■ SIMPLE EDITING

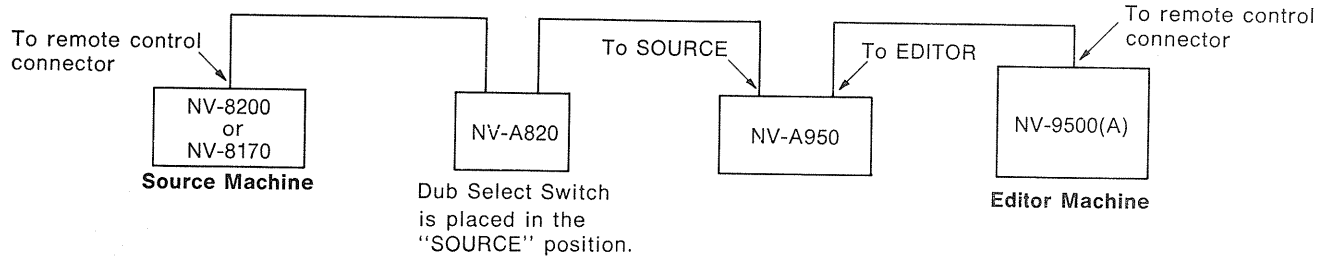
"Assemble editing" permits you to add program material to the end of a previously recorded portion, thus making one continuous, uninterrupted program from two programs. Video and audio ch1 and ch2 are editted at the same time.

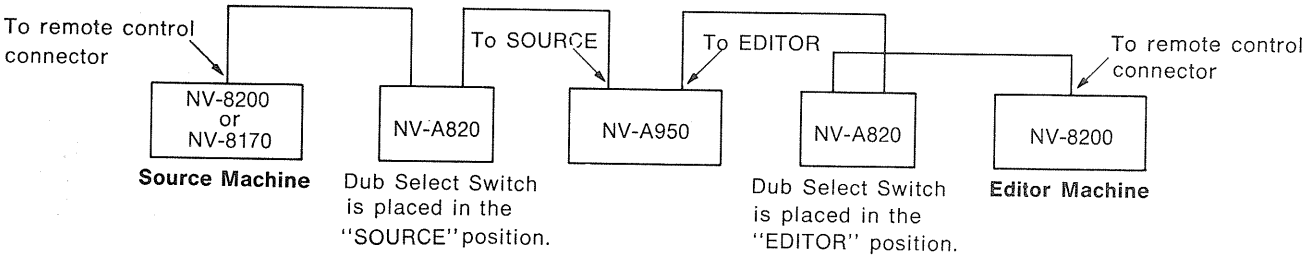
The NV-8200 itself is not capable of performing edits. However, by using the interface adaptor NV-A820, "assemble editing" can be performed.

There are 2 basic ways that the unit can be used. Either as an editor machine or a source machine.

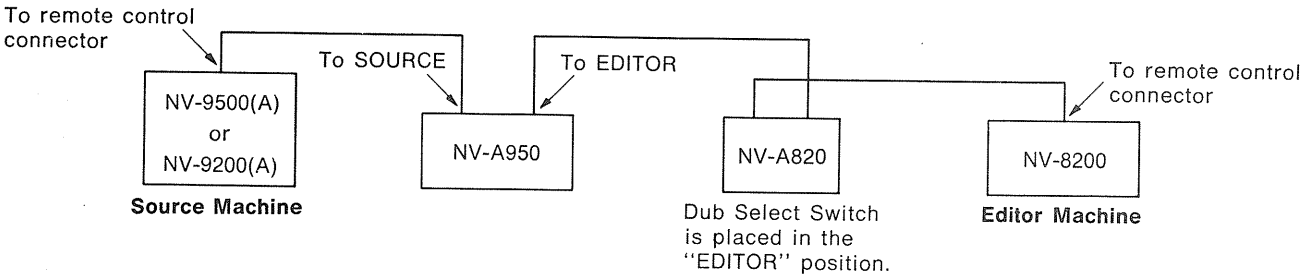
For details, read the Operating Instructions of the NV-A820.

**• When the unit is being used as a SOURCE machine.**




**• When the unit is being used as an EDITING machine.**



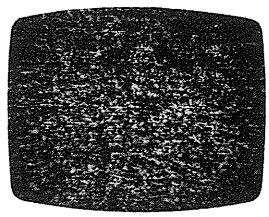

**Notes:**

- When the unit is used as an EDITOR machine, rehearsals can not be made.
- When the unit is used as an EDITOR machine, color bar will appear on the TV screen.

# VIDEO HEAD CLOGGING

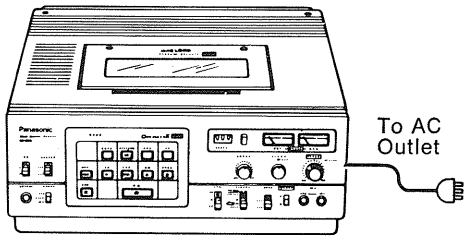
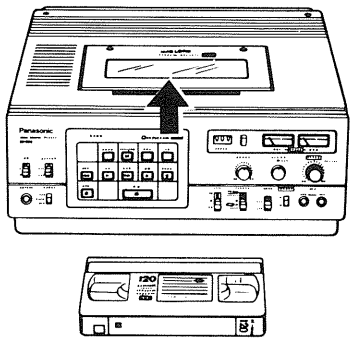
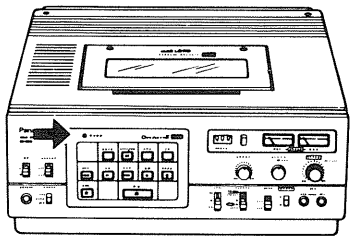
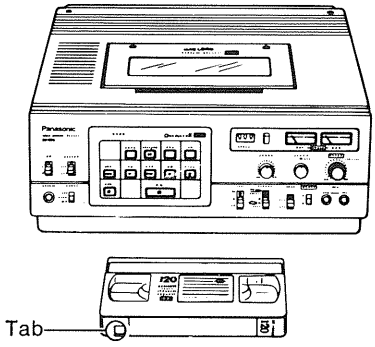
The video heads are the means by which the recorder places pictures on the tape during recording, and reads pictures from the tape during playback.
In the unlikely event that they become dirty enough to be clogged, no picture will be recorded or played back. This can easily be determined if, during playback of a known good tape, there is good sound, but no picture (picture is extremely snowy).
If this is the case, have the recorder checked by qualified service personnel.

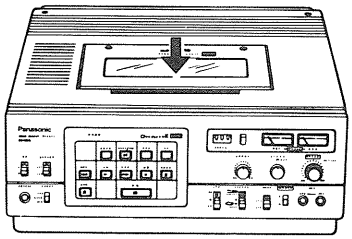
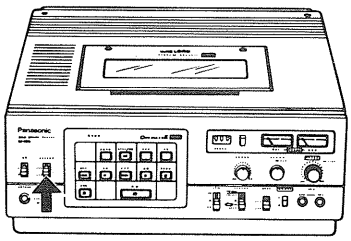
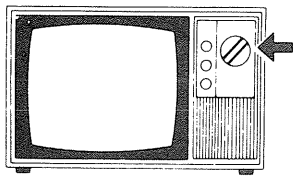
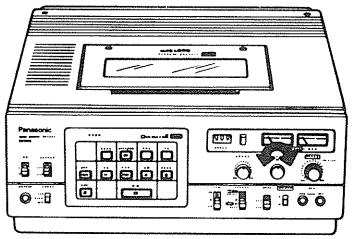
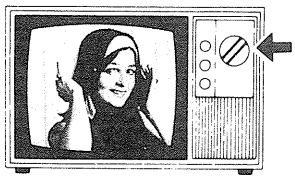
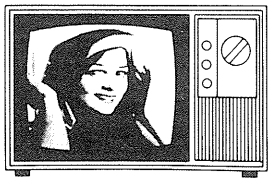
Good Picture


Snowy Picture

# BEFORE REQUESTING SERVICE

...Check the following points once again.

| Condition | Main cause and remedy | |
|---|---|---|
| If there is no power to the unit... | • Is the plug disconnected? |   |
| If the video cassette can't be inserted... | • Is it being inserted in the wrong way?<br>• The video cassette can only be inserted with window side up and safety tab facing you. |  |
| If no operation starts, when operation buttons are pushed... | Is the Dew Lamp ② on?<br>See page 28. |  |
| If no operation starts, when the Record Button or Audio Dubbing Button is pushed... | • Has a video cassette been inserted?<br>• Is the small tab on the back of the video cassette still intact? |   |

| Condition | Main cause and remedy | |
|---|---|---|
| If tape can't be rewound... | • Is the tape already completely rewound ? |  |
| If there is no playback picture... | • Is the TV/VTR Selector ③ set to the "VTR" position? |  |
| | • Is the VHF channel setting of the TV the same as that of the RF converter (channel 3 or channel 4)? |  Channel 3 or Channel 4 |
| If the playback image is noisy or contains streaks... | • Turn the tracking control. See page 28. |  |
| If there is no color in the playback image... | • Was the program broadcast in black and white?<br>• Is the fine-tuning adjustment of the TV correct? |  |
| Does the top of your playback picture wave back and forth excessively? | • Locate the horizontal hold control on your TV set. Turn it slowly to correct for the wavy picture. |  Adjust horizontal hold |

Refer servicing to qualified service personnel.

# CIRCUIT DESCRIPTION

## SYSTEM CONTROL

The System Control circuit consists of 3 boards - SY1, SY2 and SY3.

The Purpose of each board

SY1 - Memory such as PLAY, FF, Rew, etc., is performed on this board.

SY2 - The information which is memorized by SY1 is sent to this board and various circuitry action, solenoid drive, loading motor drive, etc., are processed on this board.

SY3 - Various kinds of gate circuits are located on this board.

### 1. Play Operation

#### A. Play memory circuit

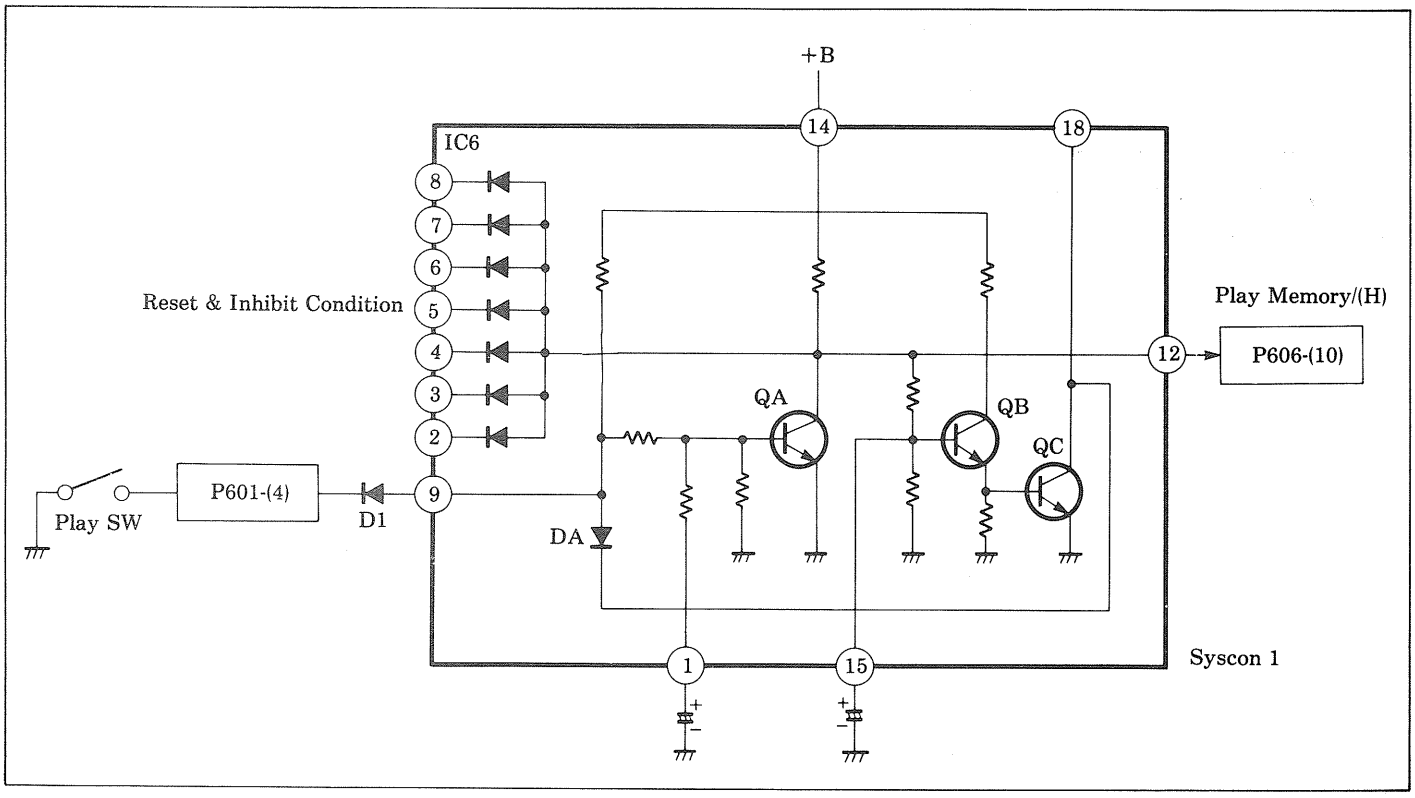



Fig. 1

When the play key is pressed, IC6-(9) is grounded through D1 (SY1). Then the transistor states inside of IC6 are set to QA (OFF), QB (ON), QC (ON). Then the cathode of DA is grounded through QC. Therefore, once the play key is pressed, it is not necessary to continue pressing the key. Thus, P606-(10) turns High.

The above description is to SET the memory of the chip.

Pins (2)-(8) are RESET (or INHIBIT) inputs

IC6-(2) When a cassette is not inserted, pin (2) is grounded (P606-(3))

(3) When the unit is placed into the STOP mode, pin (3) is grounded (P604-(10))

(4) When the EJECT memory is operating, pin (4) is grounded. (IC4-(9))

(5) When the REW memory is operating, pin (5) is grounded. (IC2-(9))

(6) When the FF memory is operating, pin (6) is grounded. (IC7-(9))

(7) When the SLOW memory is operating, pin (7) is grounded.

(8) When the X2 memory is operating, pin (8) is grounded.

When there is no INHIBIT input, as described above, the play memory will work.

I. B. Loading Operation

(Loading Motor, Loading Solenoid, Main Solenoid)
Loading operation is performed by sending a High (potential) to P606-(10) (SY1) to P610-(4) (SY2).
The High on P606-(10) (SY1) is produced when SLOW (IC3-(12)) (SY1) or X2 (IC1-(12)) (SY1) memory is operating. Therefore, loading operation can also be performed by pressing the SLOW or X2 buttons.

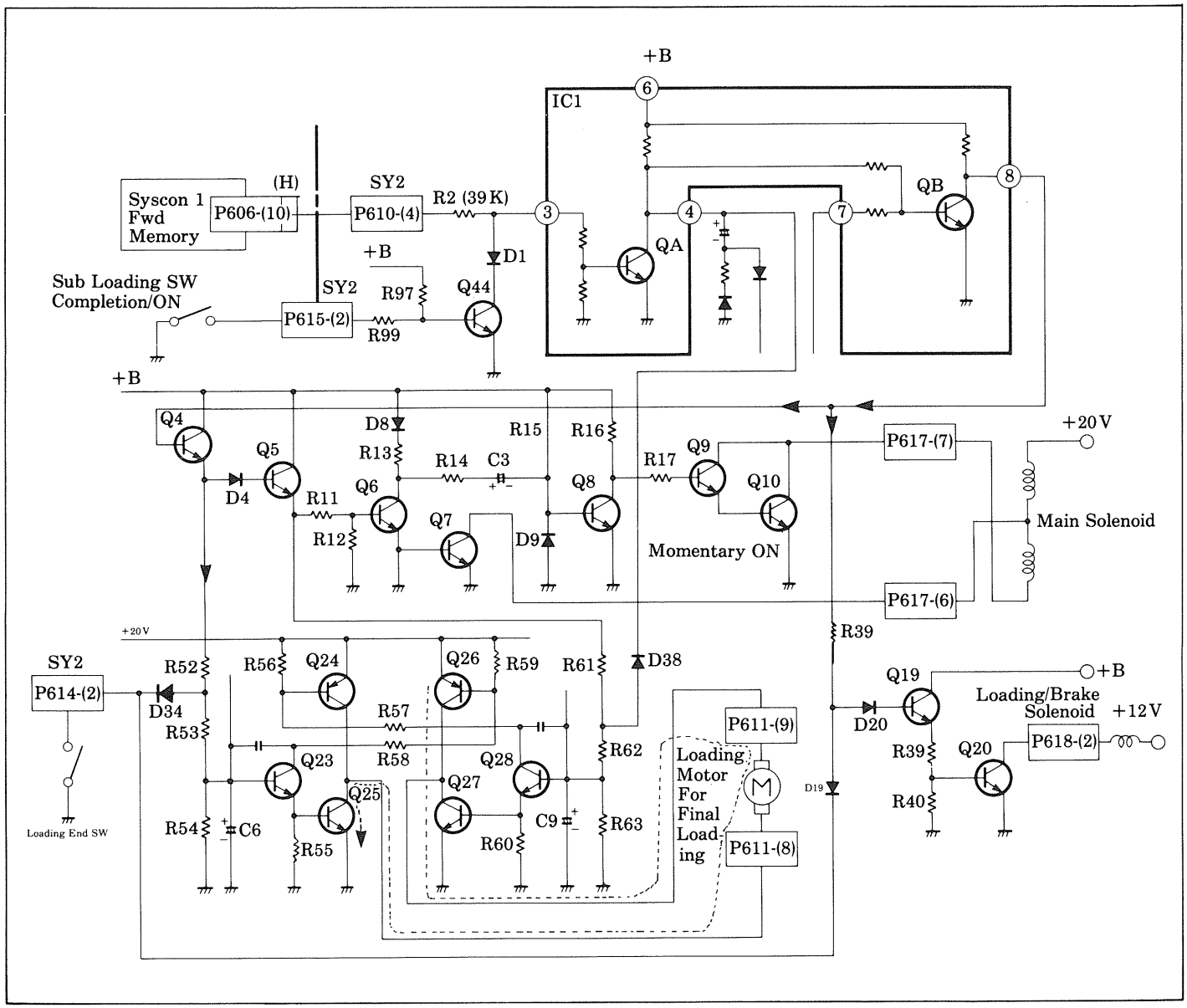



Fig. 2

The High (potential) which is applied to P610-(4) is sent to IC1-(3), then QA turns ON and QB turns OFF. Therefore, IC1-(8) will be High.

Since Q44 has been turned ON until the sub-loading is completed, IC1-(8) will send a High Signal after sub-loading completion. When IC1-(8) changes to High, the following process will be performed.

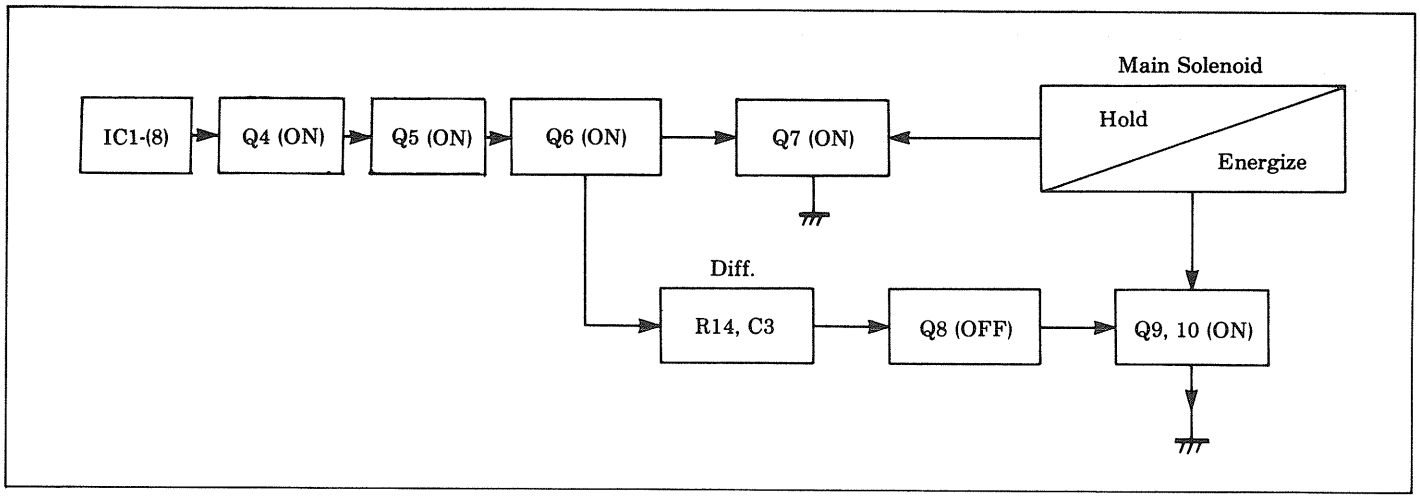



Fig. 3

Q6 turns ON and for a short while large current flows through the main solenoid to energize it. (Q9,10 ... derlington coupling). Once the solenoid is energized, to hold the condition, solenoid current flows through Q7.

For the loading solenoid operation, the same High (potential) from IC1-(8), which was used for the main solenoid drive, will be used.

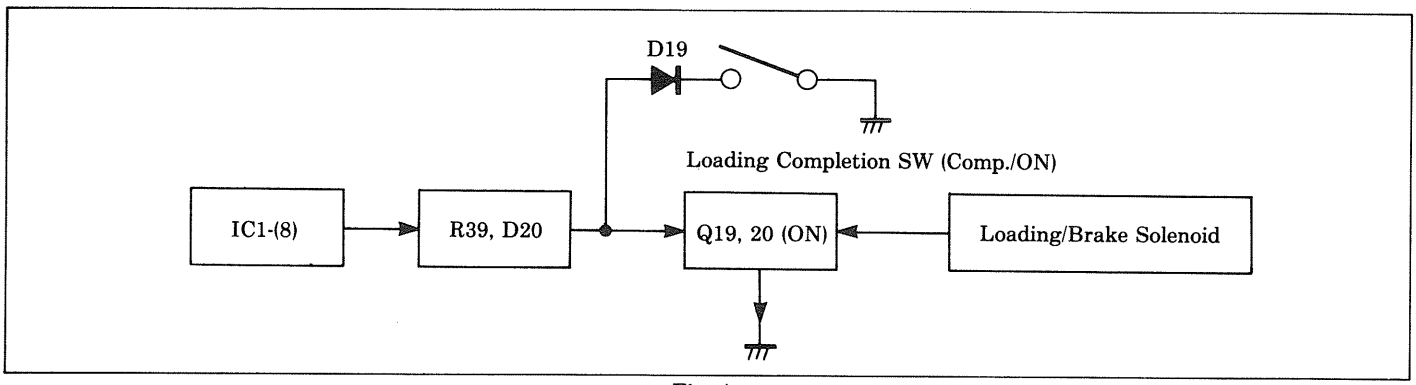



Fig. 4

The loading solenoid works only during loading. After loading completion, it is released. - - - - - - When loading is completed, the loading completion SW turns on, turning Q19 and 20 OFF because Q19 base is grounded through D19. Then the loading solenoid is released.

Operation of the loading motor is also controlled by the High from IC1-(8), but the timing is slightly delayed by C6 because this operation should be performed after the takeup reel brake is released. (Release of the takeup reel brake is performed by the main solenoid.)

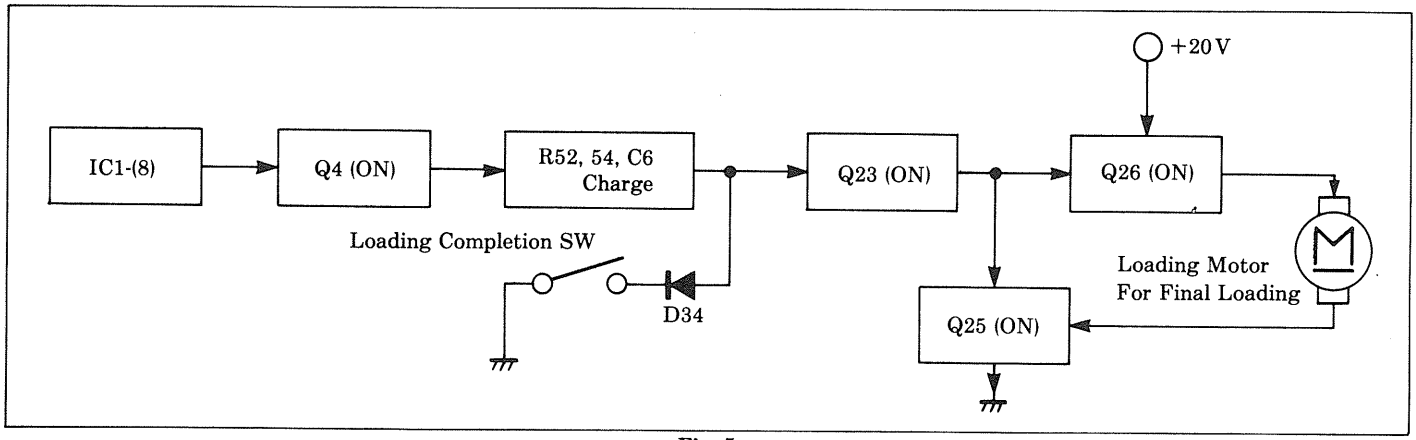



Fig. 5

The loading motor is stopped when the loading completion SW turns ON. - - - - Since the base of Q23 is grounded through D34, Q23-25 and Q26 turn OFF.

The above loading operation was performed by pressing the play key. When the unit is placed in the SLOW mode or the X2 key is pressed, the same operation is performed.

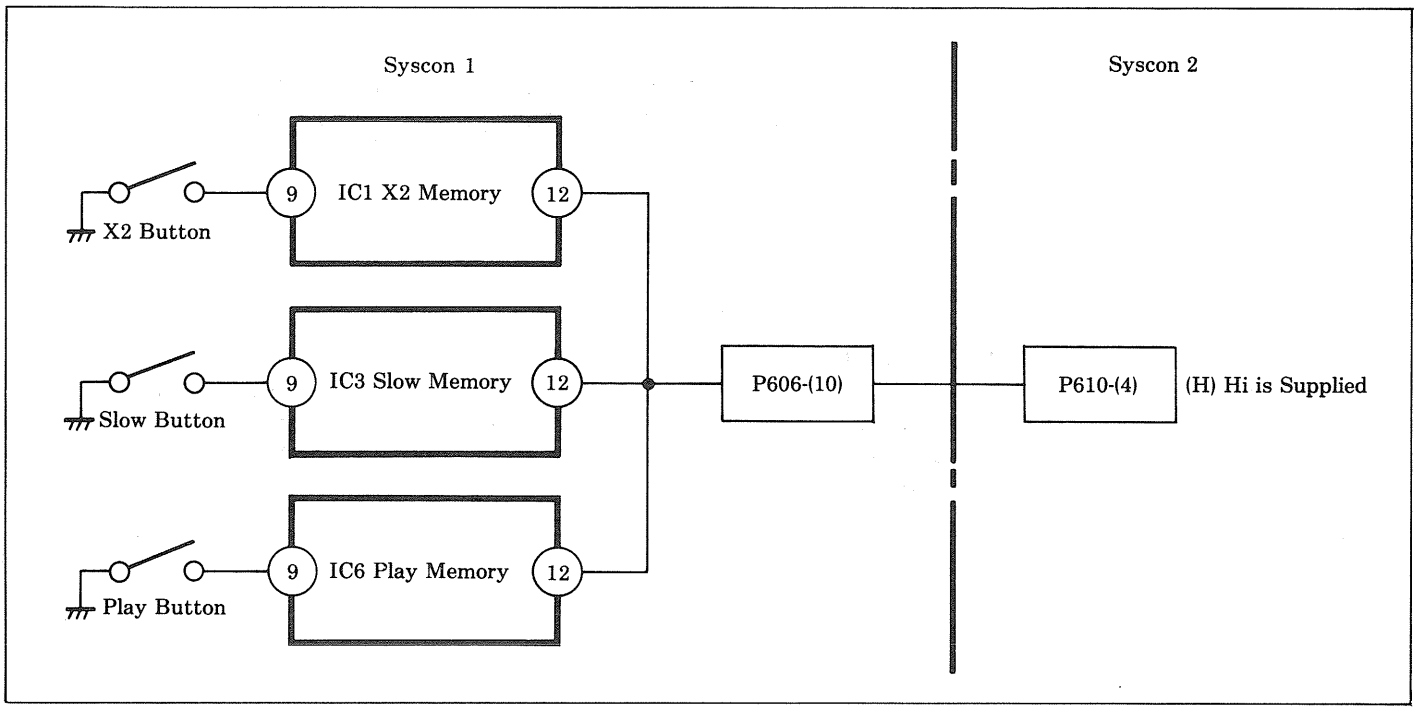



Fig. 6

I. C. Pressure Roller Solenoid Operation

The pressure roller solenoid is energized after loading completion.

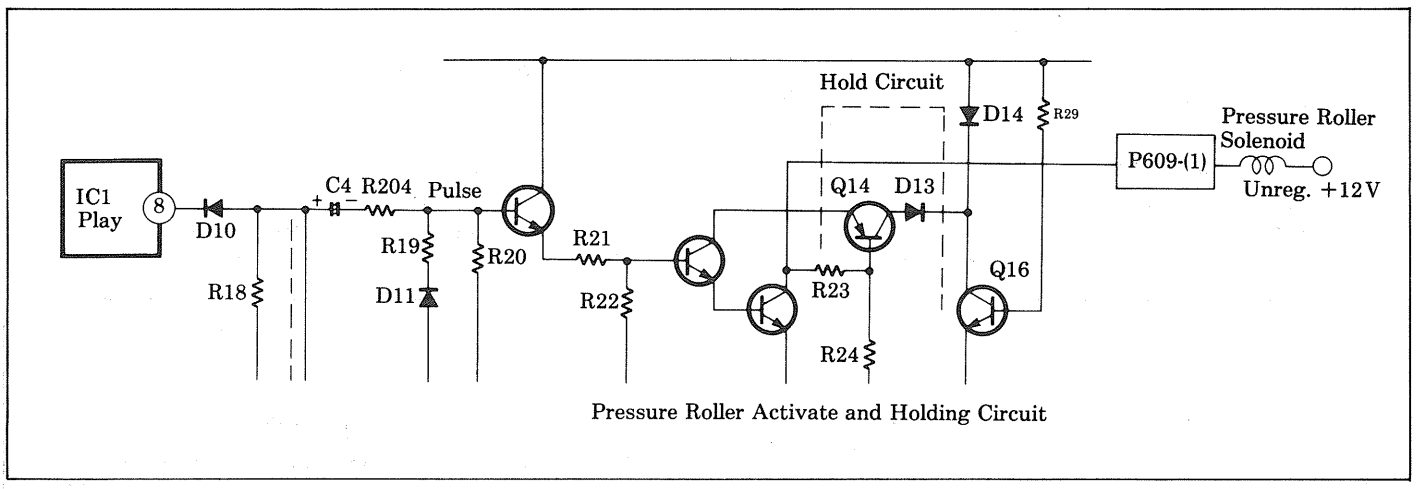



Fig. 7

When the loading completion sw turns on, P614-(2) changes to low, turning Q71 on. Then the collector voltage of Q71 is used to energize the pressure roller solenoid.

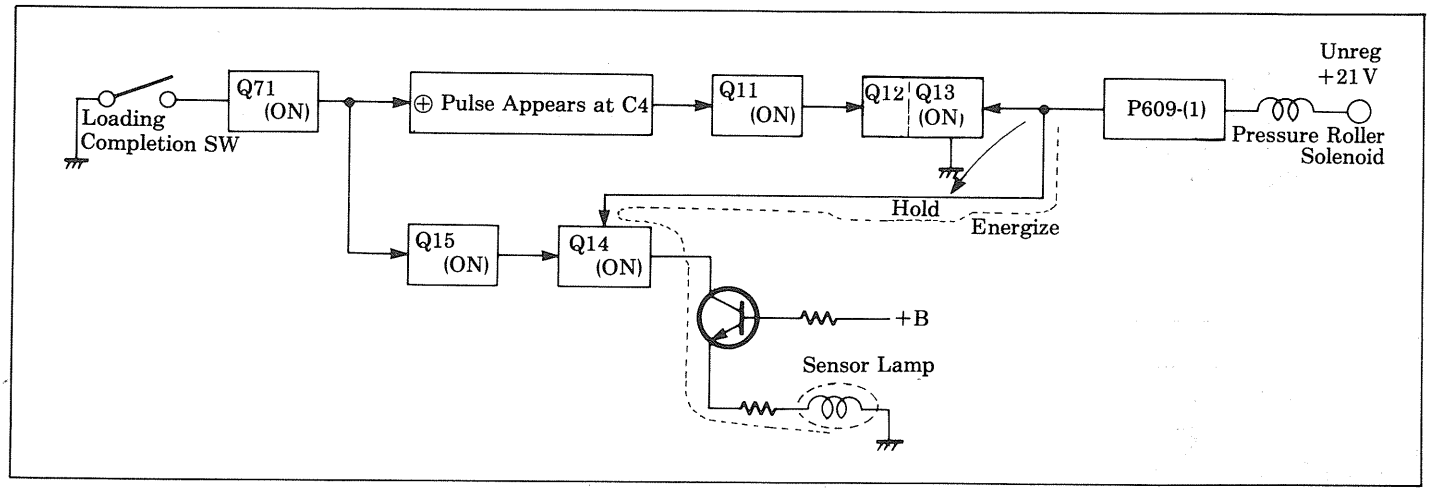



Fig. 8

To energize the solenoid, C4 will send a pulse for a short period, which turns Q11, 12 and 13 ON. To hold the solenoid, Q15 and then Q14 are active.

I.D. Unloading Operation

Unloading operation is performed by pressing the stop, FF, REN or EJECT Key during playback.

Electrial components which operate during unloading are,

(1) Loading Motor (Reverse rotation against loading)

(2) Main Solenoid (Main brake for supply reel is released)

(3) Loading Brake Solenoid (Brake is attached on takeup)

(4) REW Solenoid (Supply Reel can be rotated)

When the STOP key is pressed during playback, P610-(4) changes to Low, then IC1-(4) turns High. When IC1-(4) changes to High, B+ will be applied to the loading brake solenoid drive circuit through D21 and R41.

The voltage level (H), that was sent through R41, goes through D48 and it supplies IC3-(3).

The main solenoid and Rewind solenoid can be driven after IC3-(8) turns High. In order to drive unloading smoothly, the order mentioned below is followed.

Stop during playing → A: Main solenoid is released and stops the tape firmly (for 0.7 sec.)

Drive the loading brake solenoid and the brake contacts the takeup reel. → B: Rew solenoid is driven after stopping the tape firmly.

C: Main solenoid is driven after Rew solenoid operation. Then unloading after driving the loading motor.

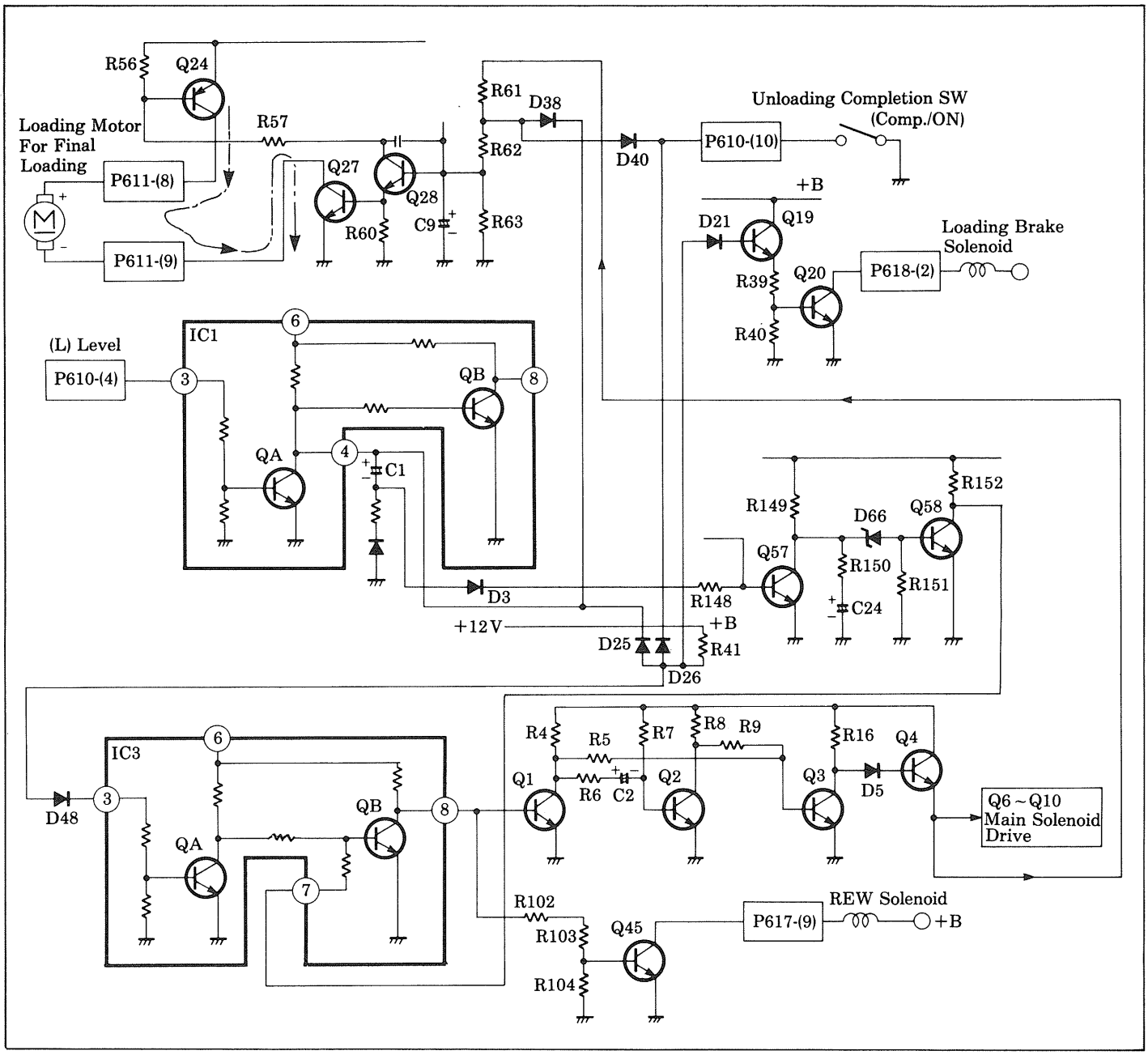



Fig. 9

(A) The voltage level (H) for IC1-(4) occurs when a (+) pulse is produced by C1 and it turns Q57 on through D3. When a (+) pulse, which is supplied to Q57 base, is removed, then Q57 collector voltage charges C24.
Q58 is cut off during charging and Q58 collector voltage is supplied to IC3-(7). Thus a High does not appear.

However, when C24 is changed to 6v, (0.7 sec), the High voltage appears at IC3-(8) when Q58 turns on.

(B) When IC3-(8) changes to a High, the Rew solenoid is activated by turning Q45 on through R102, R103. The Rewind Solenoid is activated for 0.7 sec only.

(C) IC3-(8) High turns Q1 on and Q3 base changes to a Low.
In this case, Q2 base, C2 (-) side, goes low instantly, and Q2 collector becomes instantly High. Therefore, Q2 collector turns Q3 on to produce a low level at Q3 collector. The Rewind solenoid is activated for the duration of the time constant. After that the main solenoid is held activated by Q4 which turns on.

Next, Q4 collector voltage charges C9 through D4Q5.From Q5 (E) to R61 and R62 then turns Q28 on when the base of Q28 receives a greater potential than 0.7v. And finally Q28 and Q24 are turned on.

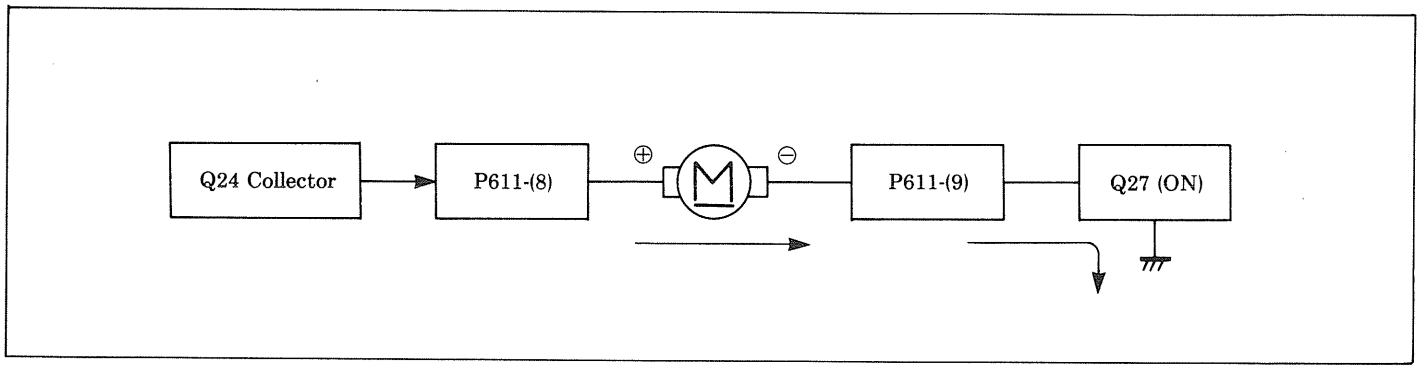



Fig. 10

As mentioned above, the loading motor starts to rotate after the main solenoid is activated.

When un-loading action is completed, the loading motor will be stopped by the following process.

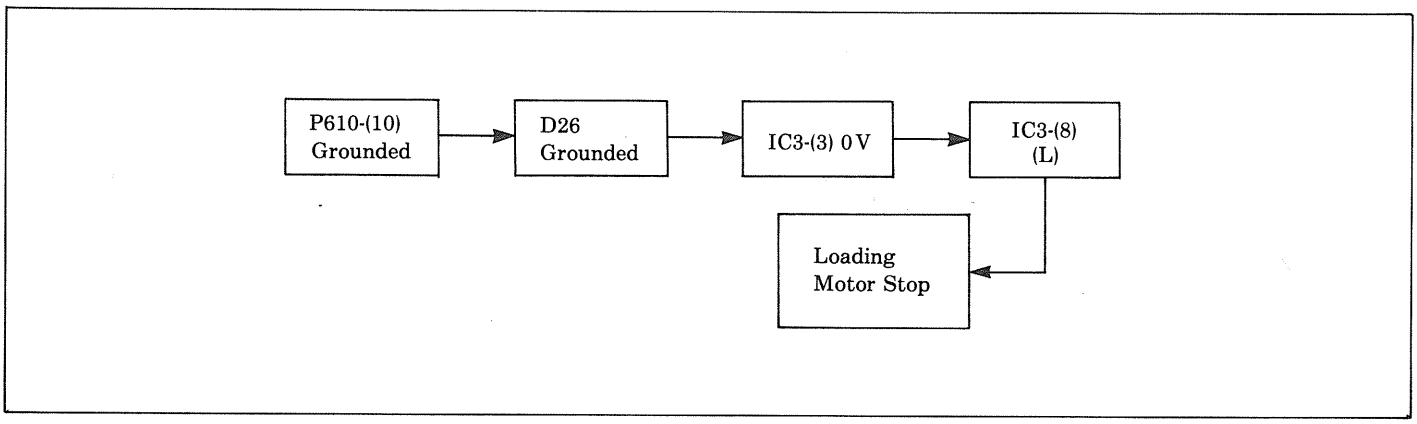



Fig. 11

I. E. Capstan motor circuit

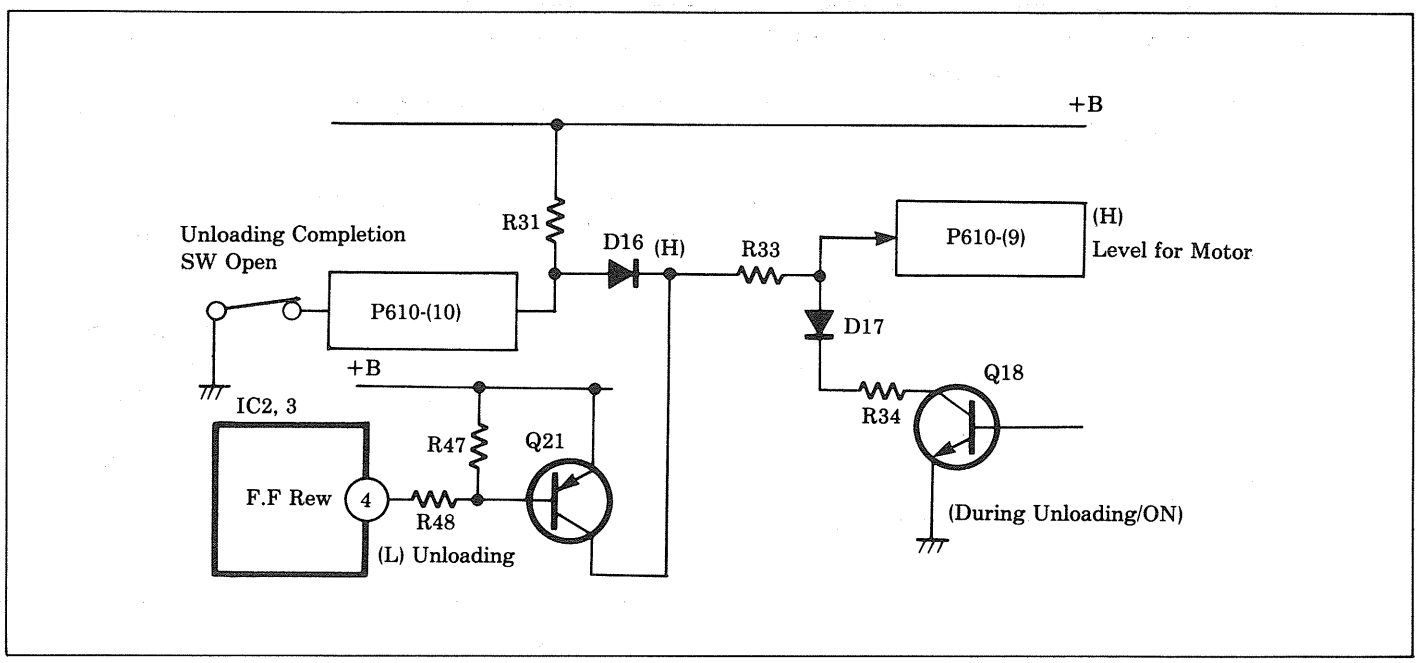



Fig. 12

Loading mode

P610-(10) open ⟶ P610-(9) High ⟶ Capstan motor on (approx. 4v)

Un-loading mode - Capstan motor is on for tape takeup.

IC3-(4) Low ⟶ Q21 ON ⟶ P610-9 ⟶ Capstan motor on (approx. 2.6v)

FF Rew mode - Capstan motor is on for transport rotation

Q21 ON ⟶ P610-(9) (approx. 4v) ⟶ Capstan Motor on.

When unloading is completed, the capstan motor does not rotate. Because when unloading is completed, P610-(10) is grounded by the loading END sw so that a High potential does not appear at P610-(9).

I. F. E-V auto change circuit

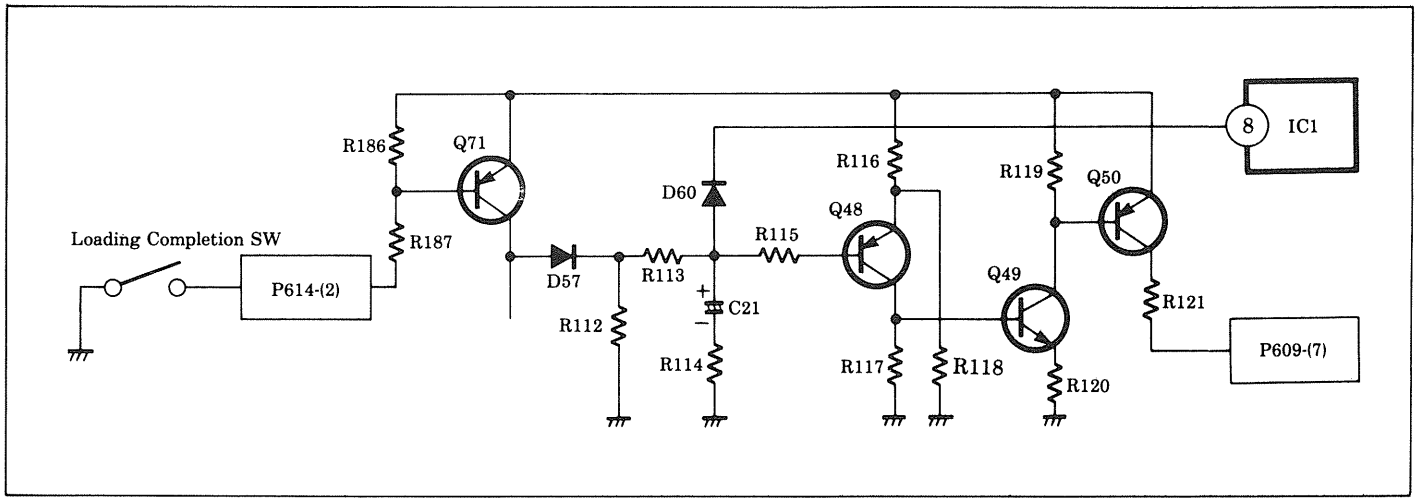



Fig. 13

When the Deck is connected to a TV monitor, E-E mode can be obtained by turning the power sw on. When the play button is pushed, a playback image appears on the TV monitor after the loading action is completed, 1-2 sec.

When the Deck is stopped, Q71 is biased to its off condition.

Q48 (ON) Q49 (ON) Q50 (ON) P609-(7) High
E-E Mode

When loading is completed Q71 turns on.

Q71 (ON) C21 charge Q48 (OFF) Q49 (OFF)
1-2 sec delay

V-V mode P609-(7) Q50 (OFF)
Low

2. REW Mode

In the REW mode, the main solenoid, REW solenoid and the capstan motor are driven.

2. A. REW memory circuit (same as play memory circuit).

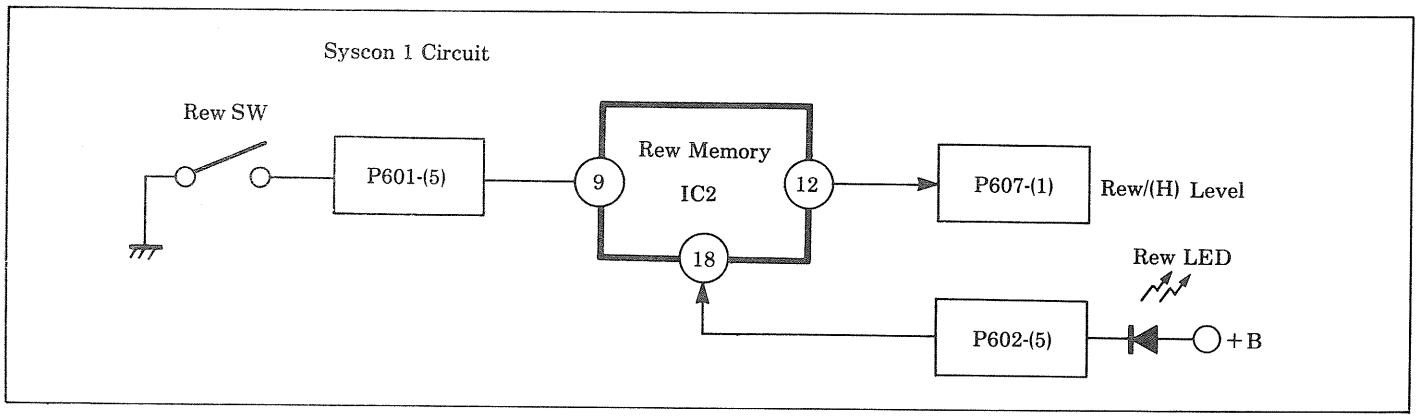



Fig. 14

When the REW sw is on, IC2-(12) changes to a High level through IC2-(9) and REW action starts. IC2-(18) low level signal lights the REW LED.

2. B. The main solenoid and REW solenoid circuit.

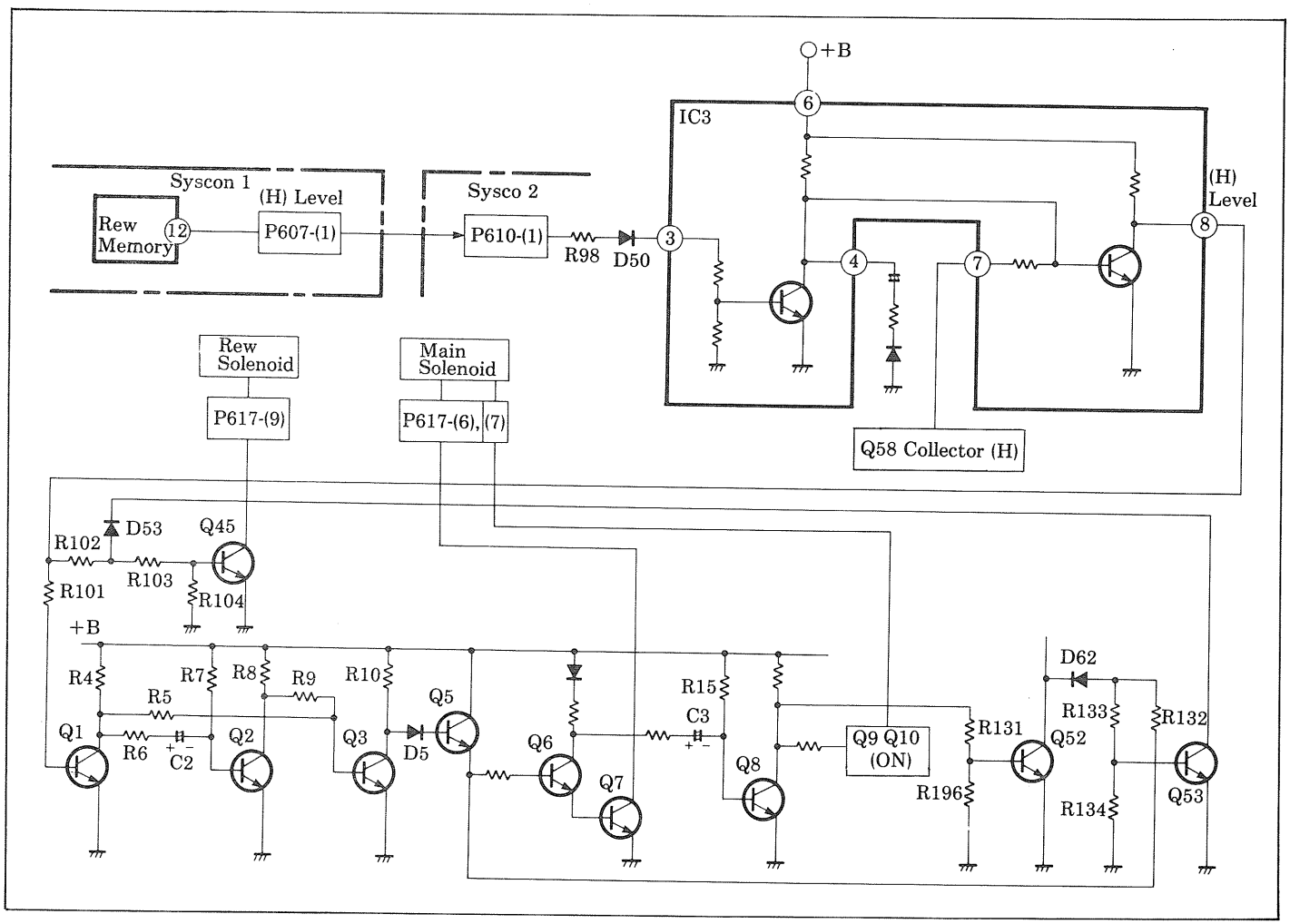



Fig. 15

A High level from the REW memory circuit, SYSCON 1, is supplied to IC3-(3) through P610-(1) on the SYSCON 2. As a result, IC3-(8) becomes High.

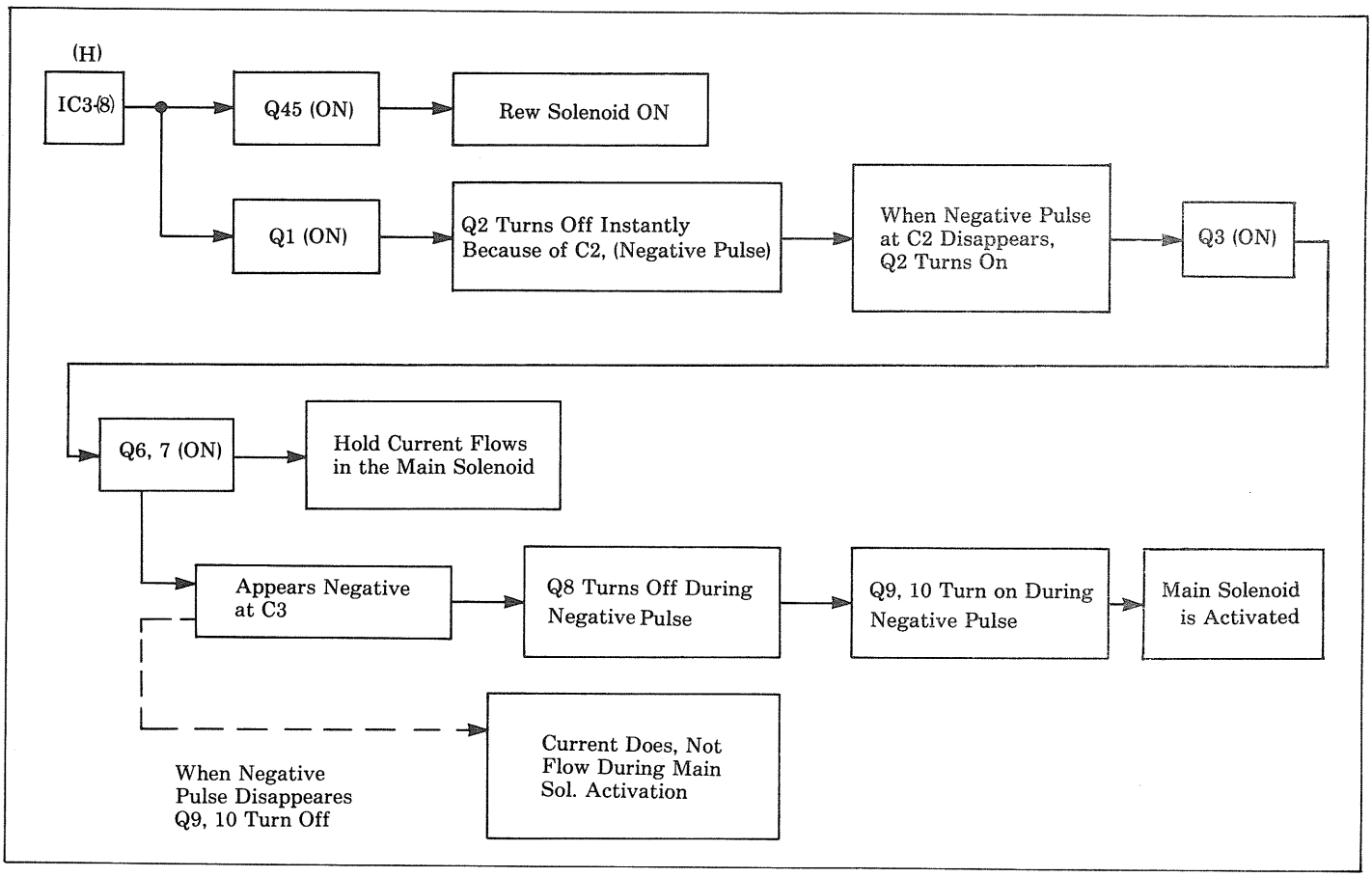

(H)
IC3-(8)
Q45 (ON)
Rew Solenoid ON
Q1 (ON)
Q2 Turns Off Instantly Because of C2, (Negative Pulse)
When Negative Pulse at C2 Disappears, Q2 Turns On
Q3 (ON)
Q6, 7 (ON)
Hold Current Flows in the Main Solenoid
Appears Negative at C3
Q8 Turns Off During Negative Pulse
Q9, 10 Turn on During Negative Pulse
Main Solenoid is Activated
When Negative Pulse Disappeares Q9, 10 Turn Off
Current Does, Not Flow During Main Sol. Activation

Fig. 16

As mentioned above, the REW solenoid is activated at first. C2 delays the main solenoid action. Then the main solenoid is absorbed. When the main solenoid is absorbed, the REW solenoid is released. The REW solenoid is only MOMENTARILY activated to place the Transport in the REW mode. This condition is held by the main solenoid activation.

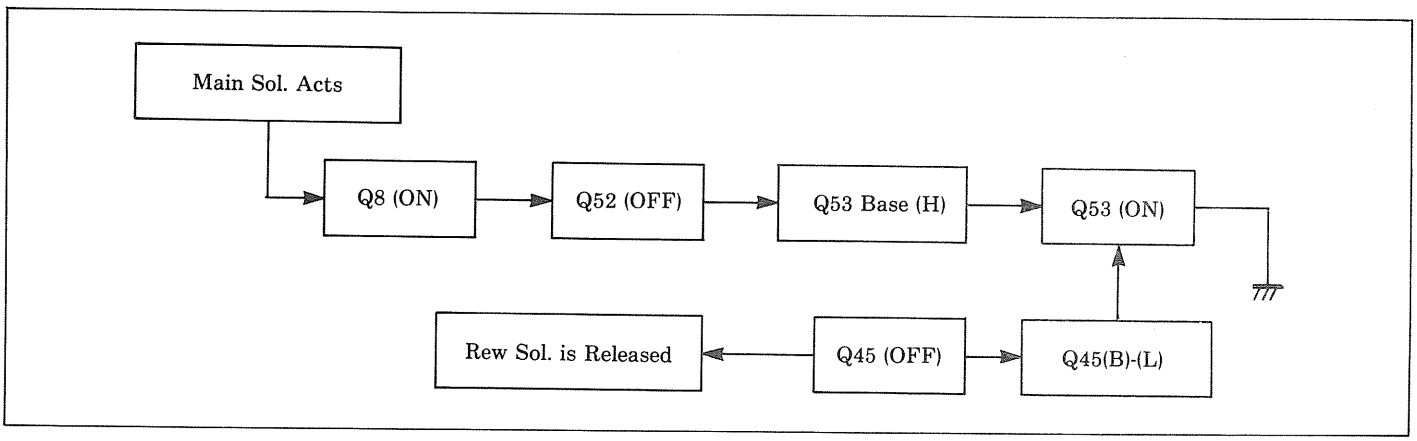



Fig. 17

As mentioned above, the main solenoid is activated, Q8, Q53 turn on and Q52, Q45 turn off. So the REW solenoid is released, the main solenoid is activated.

3. FF Mode

In the FF mode, the main solenoid, the FF solenoid and the capstan motor are activated.

3. A. FF memory circuit (Same as play memory circuit).

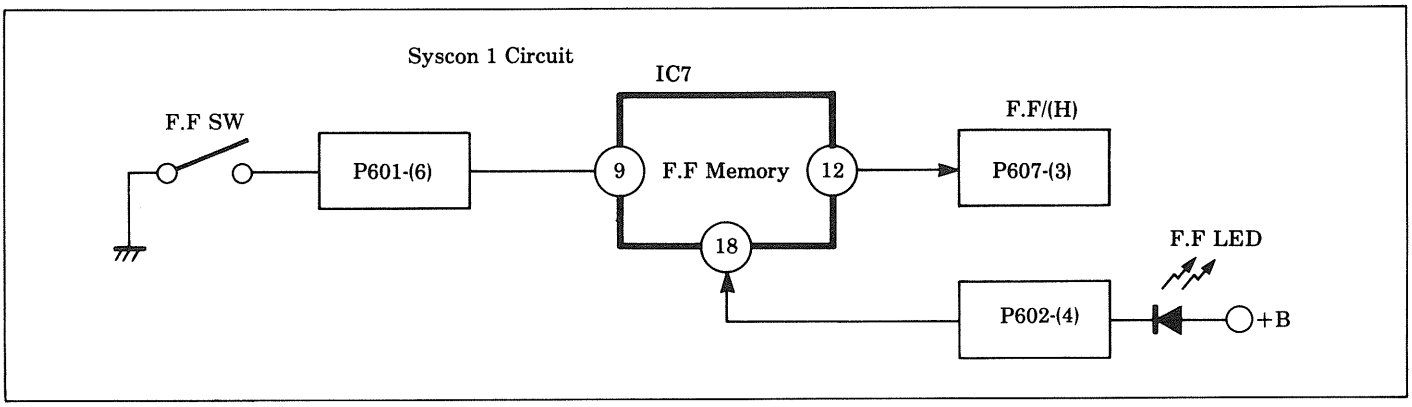



Fig. 18

When the FF sw is on, IC7-(9) changes to a Low and IC7-(12) to a High. So the FF action is performed. The low at IC7-(18) lights the FF LED.

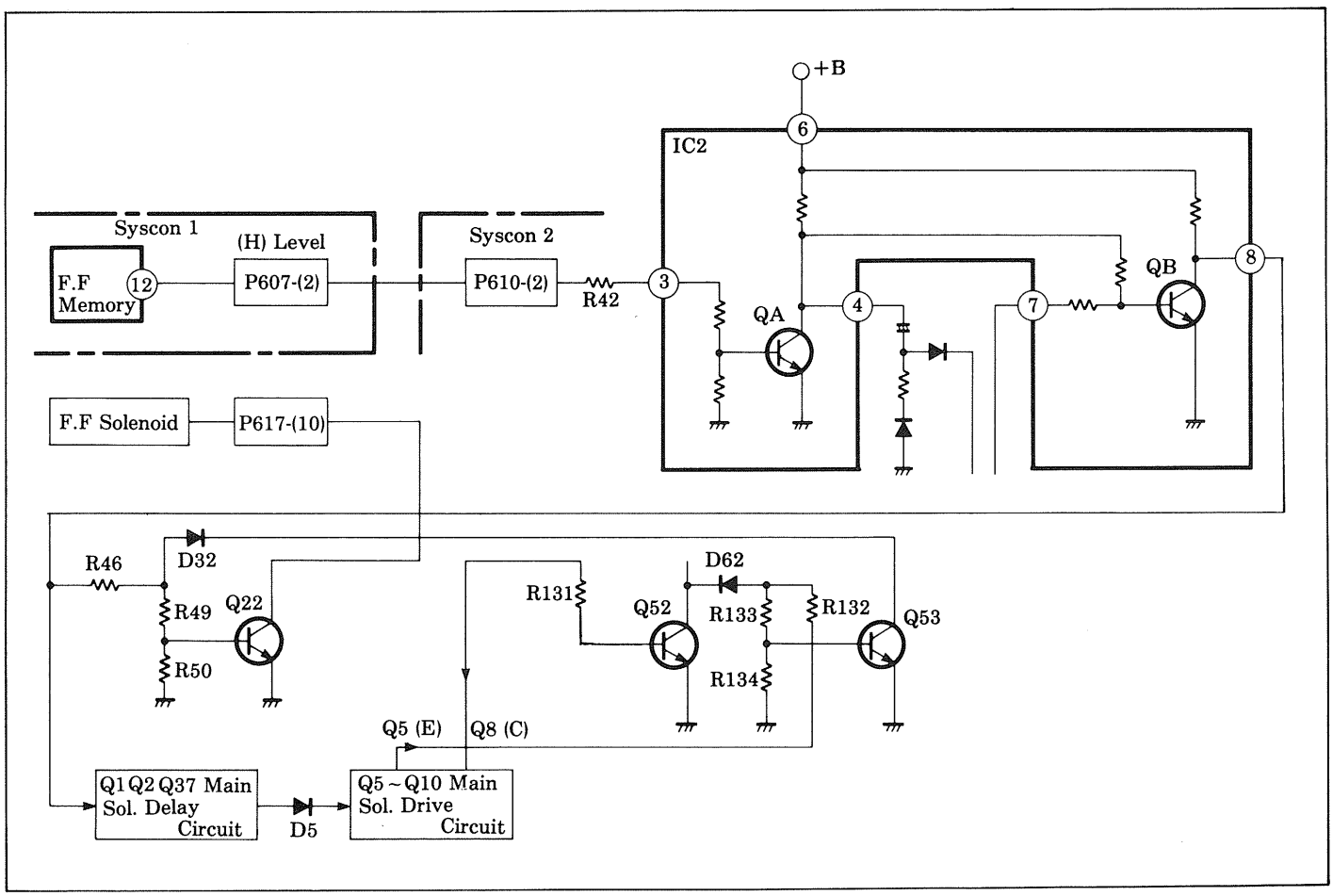



Fig. 19

A High level at the FF memory circuit, SYSCON 1, is supplied to IC2-(3), through P610-(2) so that IC2-(8) turns High. The IC2-(8) High activates the FF solenoid through Q22 which turns on. The main solenoid action is the same as the REW and play mode, refer to pages 1-36 and 1-44.

Thus, after the main solenoid is absorbed, the collector of Q8 turns Low. So Q52 and Q22 turn off and Q53 turns on. As a result of it, the FF solenoid is released. The FF solenoid is activated until the main solenoid activation releases the FF solenoid.

3. C. The capstan motor circuit.

Same as the play circuit description, refer to page 1-41.

4. Eject Mode

During the Eject mode, the Eject solenoid, main solenoid, and loading brake solenoid are activated to release the cassette holder lock mechanism. This eject action is performed after the sub un-loading action is completed.

4. A. Eject memory

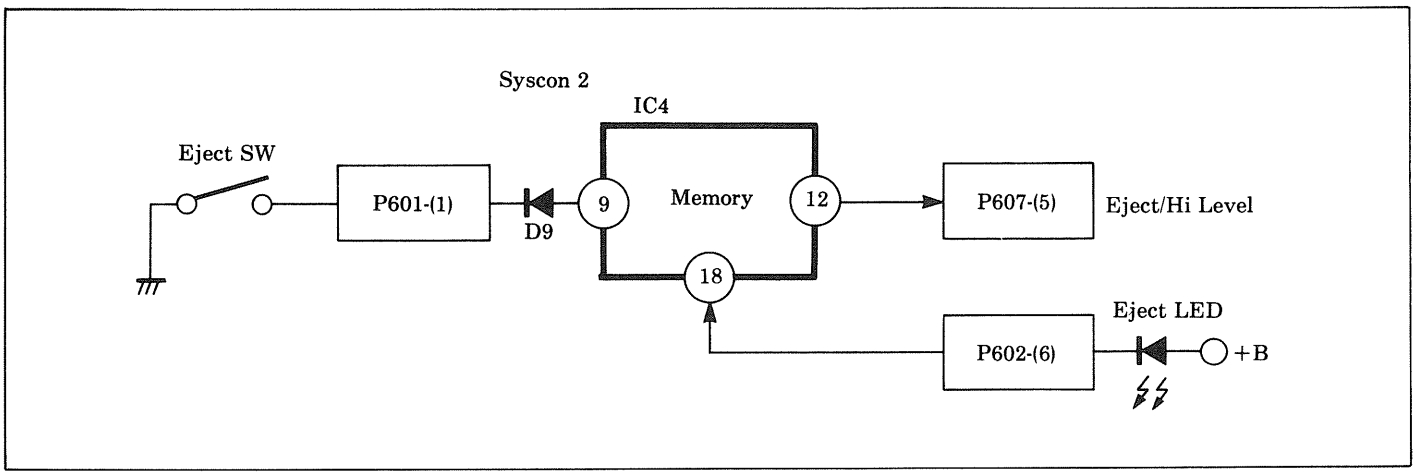



Fig. 20

When the Eject sw is pushed, IC4-(12) on the SYSCON I turns to a high level which is supplied to the SYSCON II circuit.
The low level at IC4-(18) will light the eject LED which is on the operation panel.

4. B. Sub-unloading action

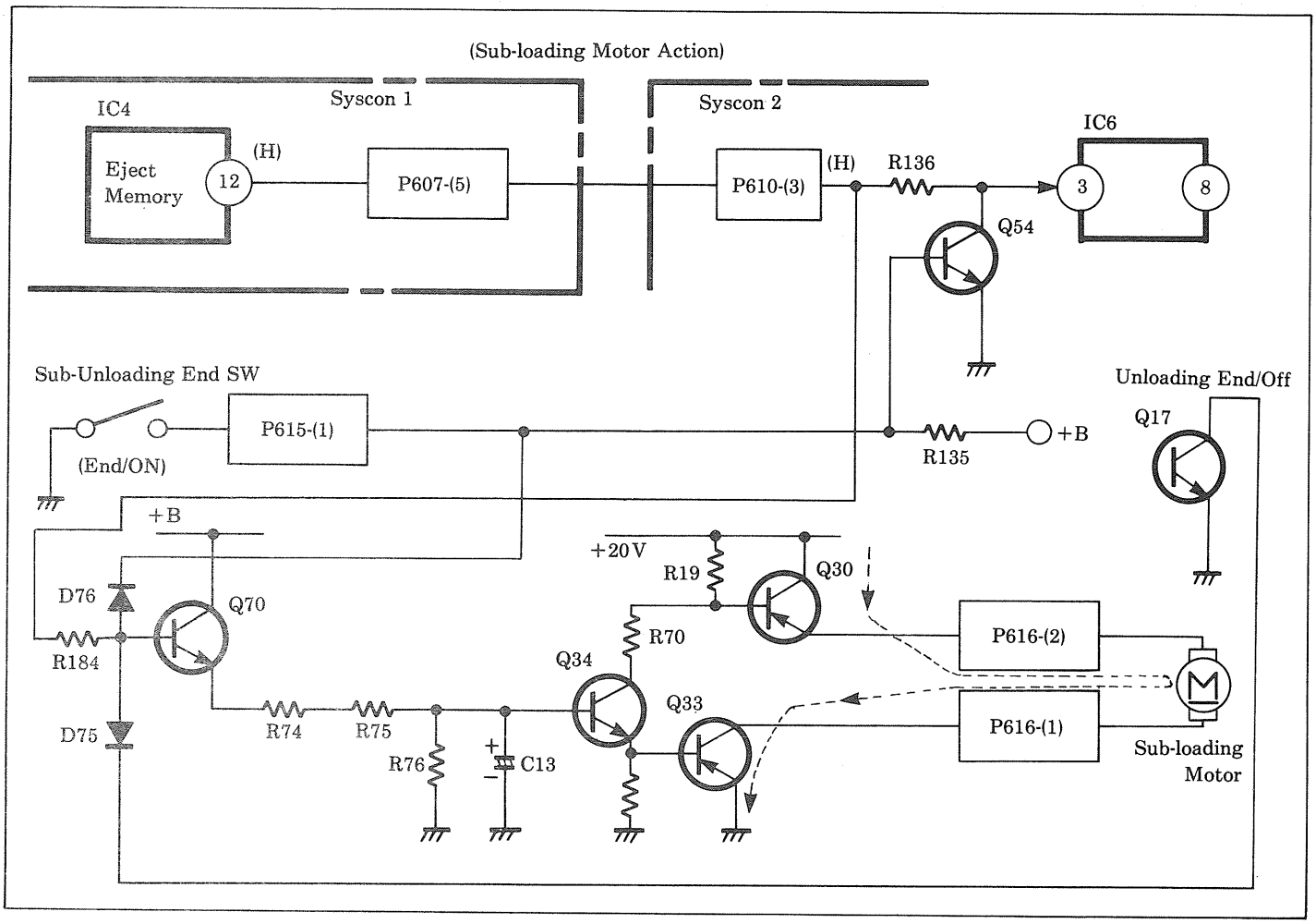



Fig. 21

The High level at P607-(5) on the SYSCON I is supplied to P610-(3) on the SYSCON II. This high level is supplied to the base of Q70 and IC6-(3). Q54 is connected with IC6-(3) so Q54 turns on to maintain a low level at IC6-(3).

The voltage at the emitter of Q70 charges C13 when Q70 turns on. While C13 is charging, the main solenoid is activated, and C13 turns Q34 on to perform sub-unloading.

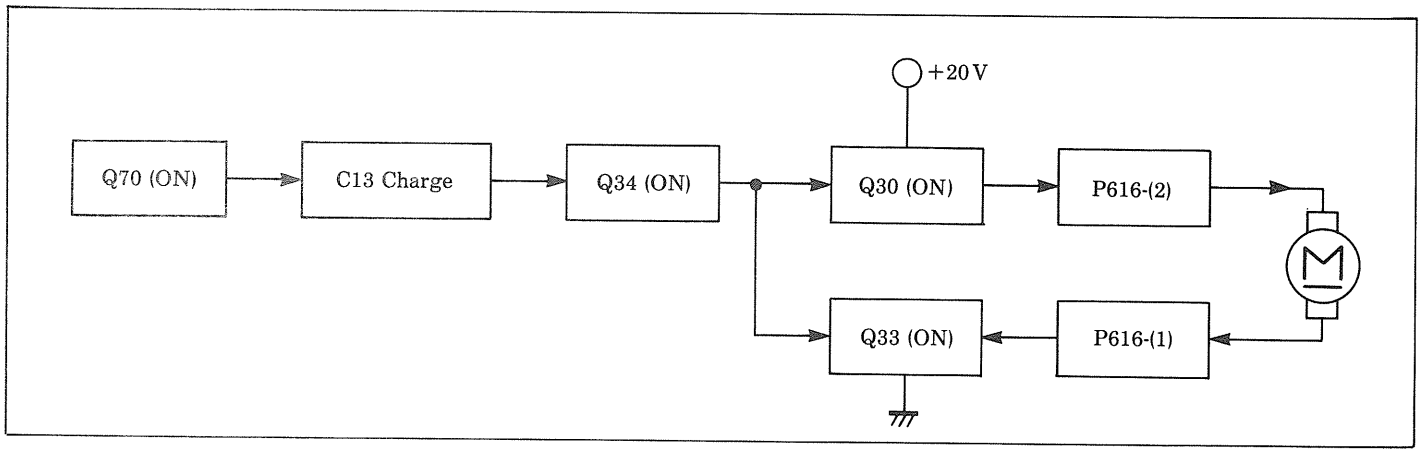



Fig. 22

When the sub-unloading is completed, Q70 turns off by grounding the base through D76. Therefore, the sub-loading motor will stop because Q30, 33 and Q34 turn off.

(2) Main solenoid, loading brake solenoid action.

Before sub-unloading is performed, the main solenoid and loading brake solenoid are activated so that the tape can only move to the supply reel table. Namely, REW action is performing to roll the tape when sub-unloading is activated.

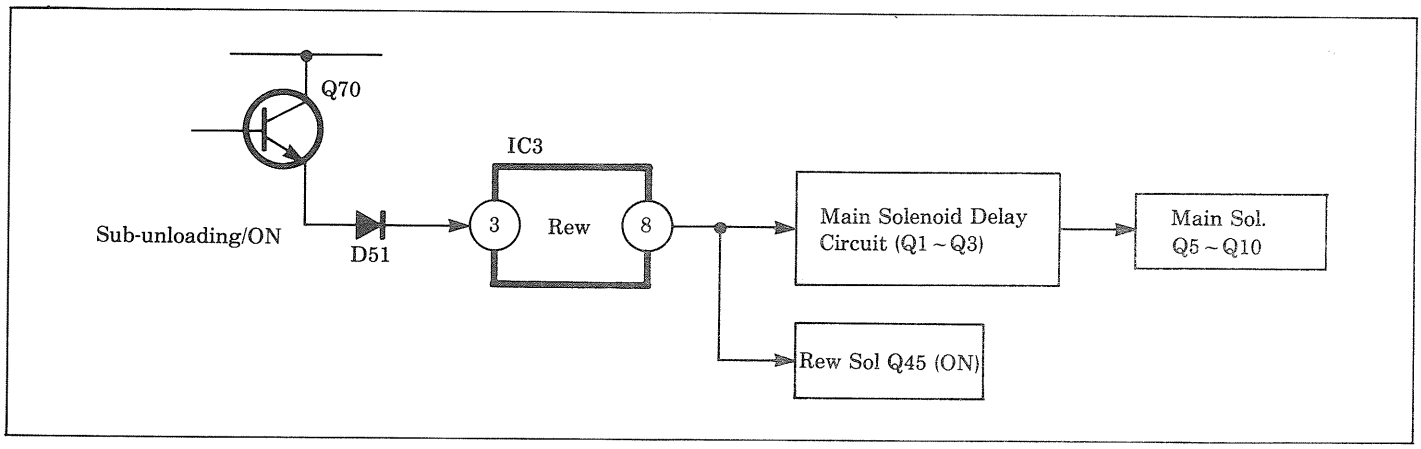



Fig. 23

The emitter voltage at Q70 is supplied to IC-(3) through D51 to produce a high level at IC3-(8). As a result, the main solenoid and REW solenoid is activated.

The REW Solenoid is only momentarily activated to place the transport in the REW mode. REW mode is held by the main solenoid activation.

(3) Capstan motor circuit.

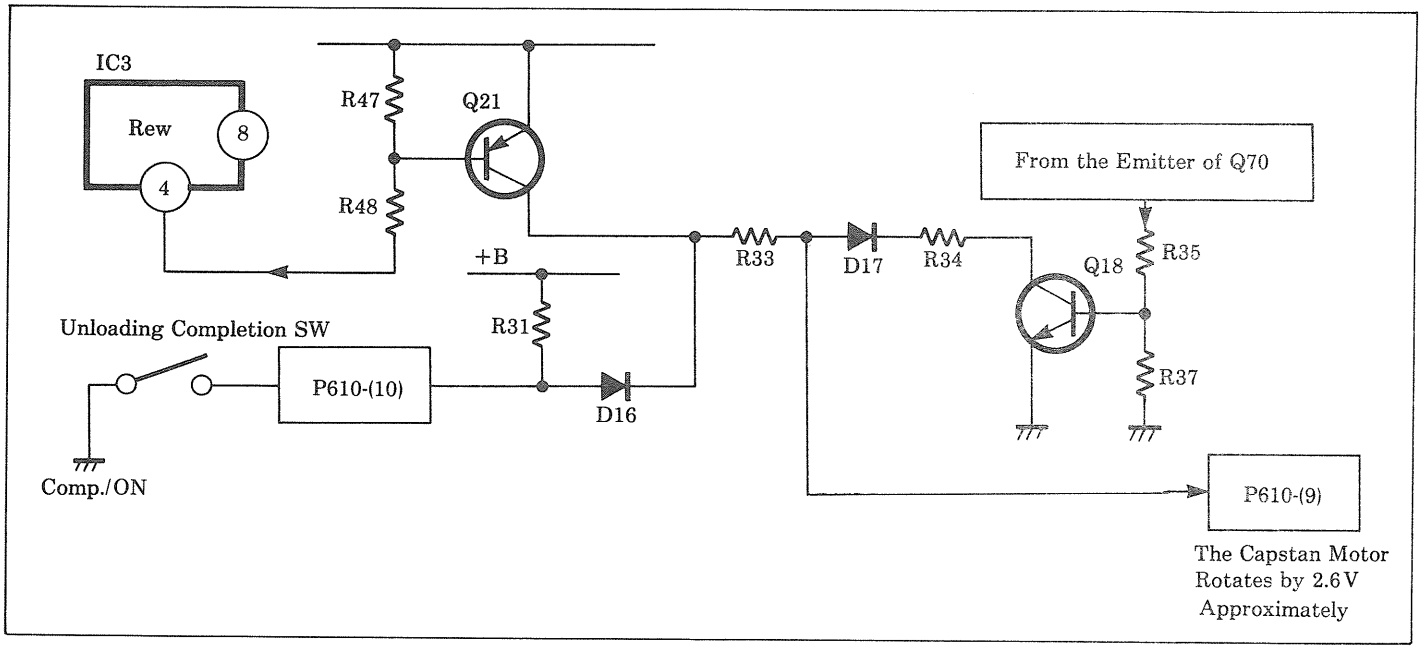



Fig. 24

The Deck is in the unloading END mode, so the anode of D16 is grounded.

The capstan motor, during sub-unloading, is driven by the voltage from R33, D17, R34 which are connected with the collector of Q21.

## 4. C. Eject Circuit

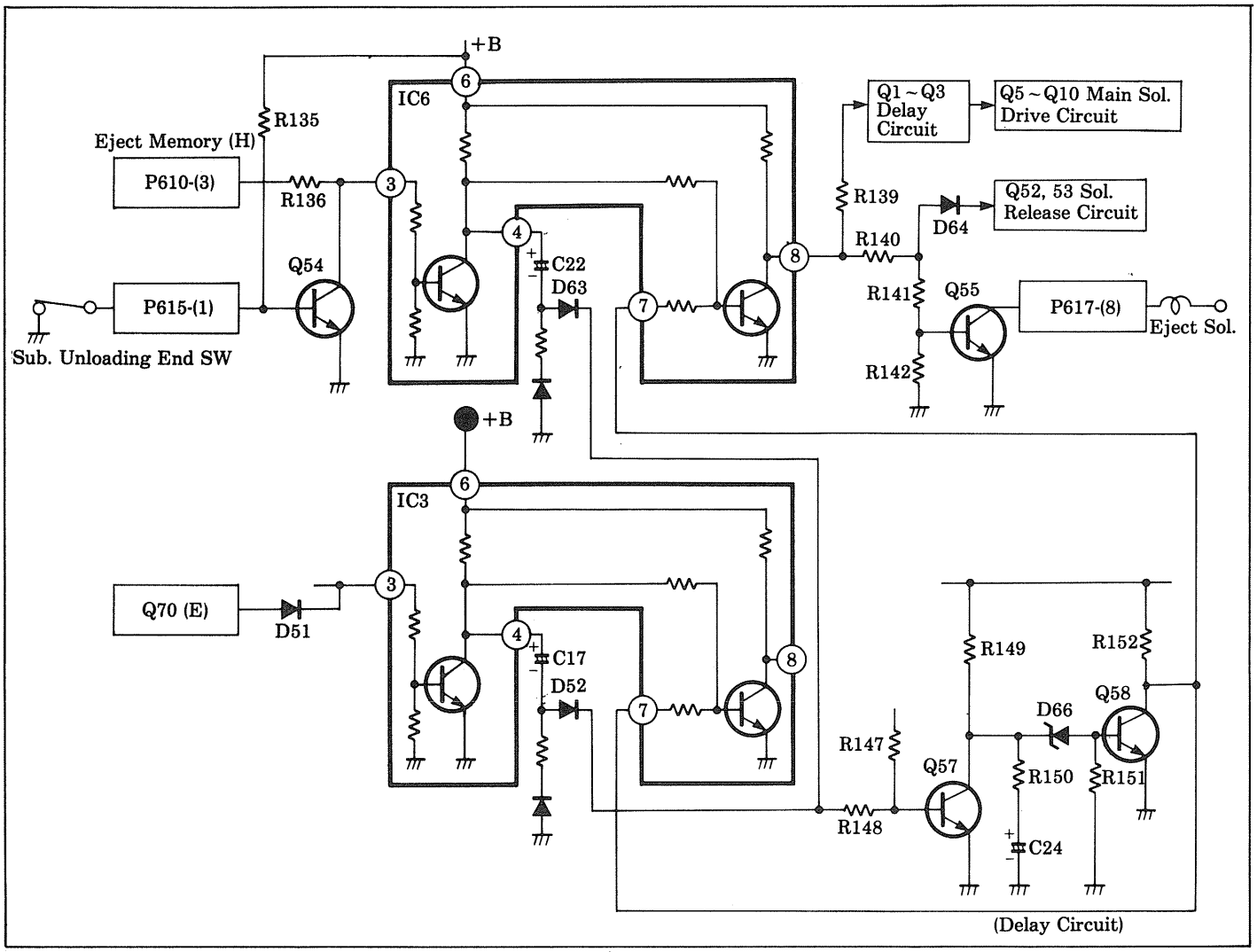



Fig. 25

Eject action performs 0.7 seconds after sub-loading has ended.
When changing from the REW mode to the FF mode, the FF mode performs directly without having to push the Stop sw.
The stop mode is performed automatically by a 0.7 sec. delay circuit which consists of Q57, 58.

During sub-unloading, IC3-(4) is kept at a low level.
After completing sub-unloading, the following process is performed.

IC6-(8) High occurs 0.7 sec. later because of the Delay circuit which consists of Q57, Q58 (C24 charge) after sub-unloading is completed.
The High at IC6-(8) turns Q55 on, and the eject solenoid is activated.
At the same time, the main solenoid drive circuit which consists of Q5-Q10 is activated through Q1-Q3, the main solenoid delay circuit.

When the main solenoid is activated, the Eject solenoid is released by the solenoid release circuit which consists of Q52, Q53.

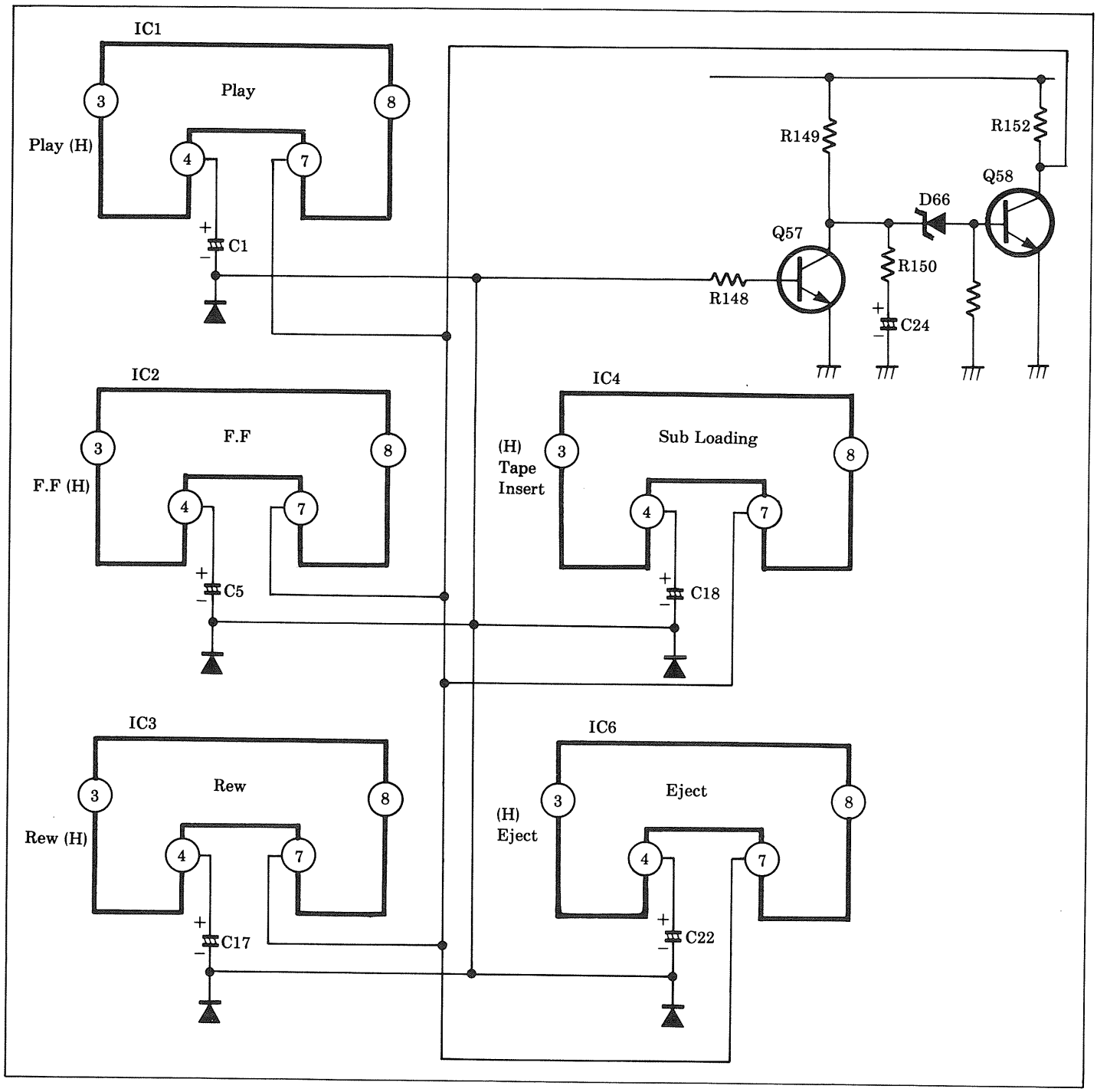



Fig. 26

Q57, Q58, 0.7 sec delay circuit and IC modes' are show above. The following mechanism action occurs.

| Mode | Button | 0.7 Sec Delay | Mechanism Action | 0.7 Sec | Mechanism Action | 0.7 Sec Delay | Mechanism Action |
|---|---|---|---|---|---|---|---|
| → | Rew ON | ○ | Unloading → | ○ | Rew | | |
| → | F.F ON | ○ | performs. → | ○ | F.F | | |
| Play→ | Eject ON | ○ | After ended unloading → | ○ | Sub-Unloading | ○ | Eject Action |
| → | X2 ON | × | X2, slow mode changes mode directly to X2 mode | | | | |
| → | Slow ON | × | or slow mode 0.7 sec delay circuit does not work. | | | | |

Fig. 27

5. X2 Mode

In the X2 mode, the capstan motor is driven at the double speed of normal playback. This means that the capstan servo has to be changed.

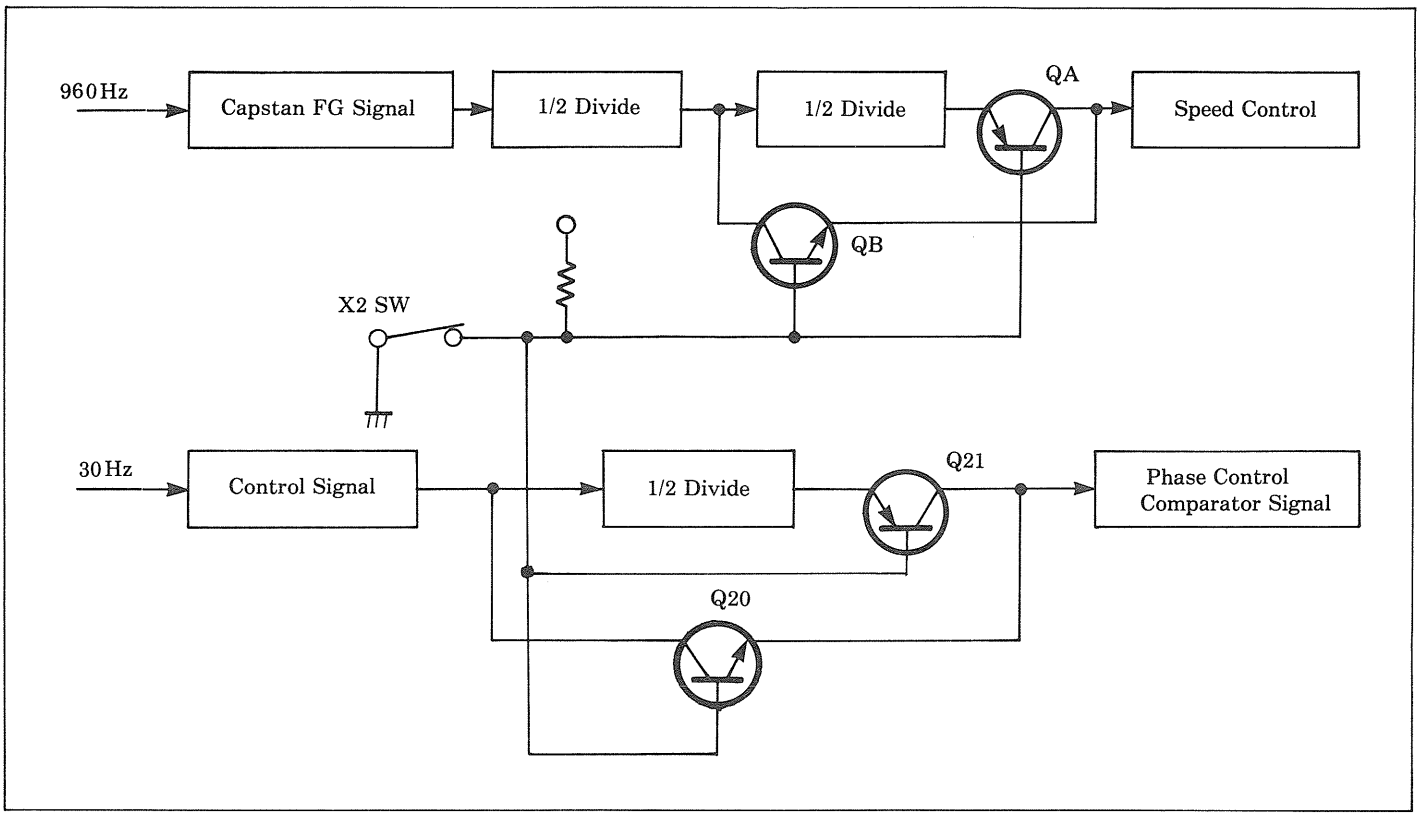



Fig. 28

Speed control

In the normal mode, the tape speed is 33.35mm/s, and the capstan FG signal is 960Hz. The FG signal is divided into half and as a result of this, speed control is performed during the X2 play mode.

When X2 sw is pushed, QA turns on and QB turns off. So 240Hz is supplied to the speed control circuit. In this case, the speed control circuit tries to double the capstan motor speed.

Phase Control

During the normal speed mode, phase control is performed with the 30Hz control signal through Q20. However, when the X2 sw is pushed, the capstan speed doubles. Therefore the control signal changes to 60Hz. 60Hz is divided by half and is supplied to the phase control circuit through Q21.

As mentioned above, the X2 mode is driven by the FG signal from the capstan output and control signal from the control head.

5. A. X2 Memory Circuit

(This circuit is the same as the play memory, see page 1 - 33.)

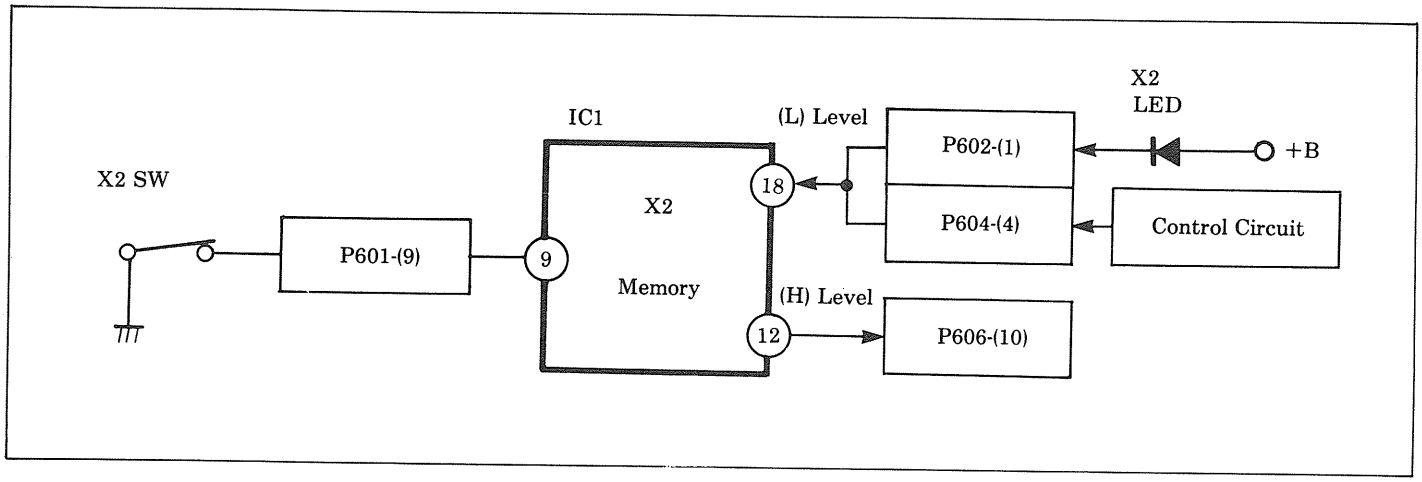



Fig. 29

When the X2 sw is pushed, IC1-(12) changes to a high level and is routed to P606-(10). This high level is supplied to the SYSCON II circuit which drives the loading circuit.

A low level signal at IC1-(18) lights the X2 LED which is connected to P602-(1).

This low level signal is also supplied to the servo circuit through P604-(4) for double speed.

5. B. X2 Control Circuit (same as NV-8310)

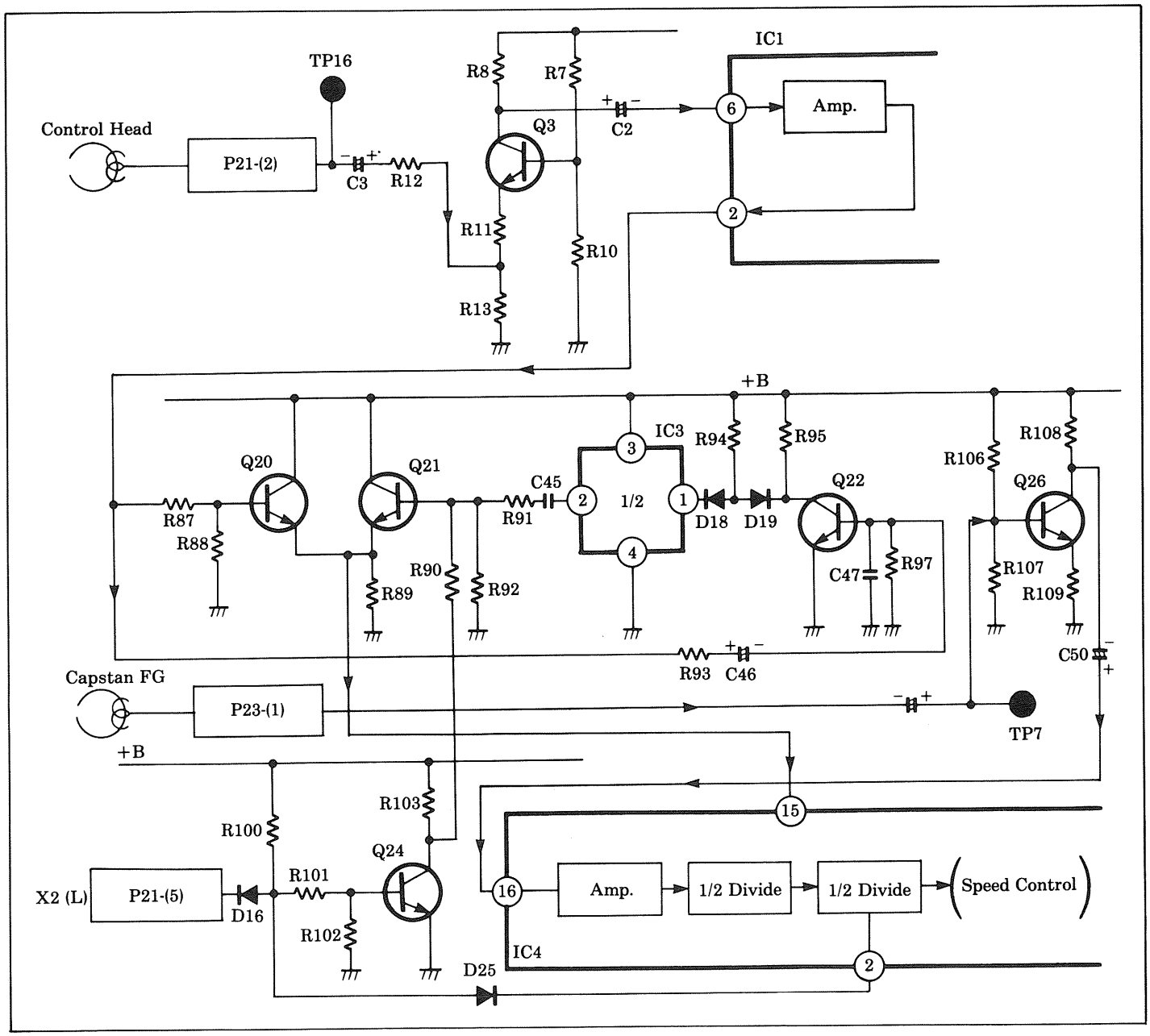



Fig. 30

During normal mode, the high level at P21-(5) turns Q24 on, and IC4-(2) is High. The capstan FG signal at IC4-(16) is divided by half through a Flip-Flop within IC4.

The control head signal is amplified by Q3, and is supplied to Q20, Q22. During the normal mode, the control signal is supplied to IC4-(15) through Q20.

When the X2 sw is pushed, P21-(5) changes to a low level and no voltage appears at IC4-(2). When the above occurs, the FG input signal at IC4-(16) is divided by 1/4 whereby a 240Hz signal is obtained. As a result of this, the capstan motor rotates at double speed.

And then, Q24 turns off because of a low level signal.
A High level at the collector of Q24 turns Q21 on to pass 60Hz through Q22.
And a 30Hz signal is supplied to IC4-(15) to drive the phase control circuit.
When the mode is X2, Q20 is turned off because the base voltage at Q21 is higher than Q20.

6. Slow Mode

When the slow mode performs, the capstan motor speed can be varied from 0.2 to 1.5 times of its normal playback speed by controlling the variable resistor for slow mode. This slow variable resistor changes the control voltage which is supplied to the capstan drive circuit. However, the capstan phase control does not work at this time.

6. A. Slow memory circuit

(This circuit is similar to the play memory, see page 1-33.)

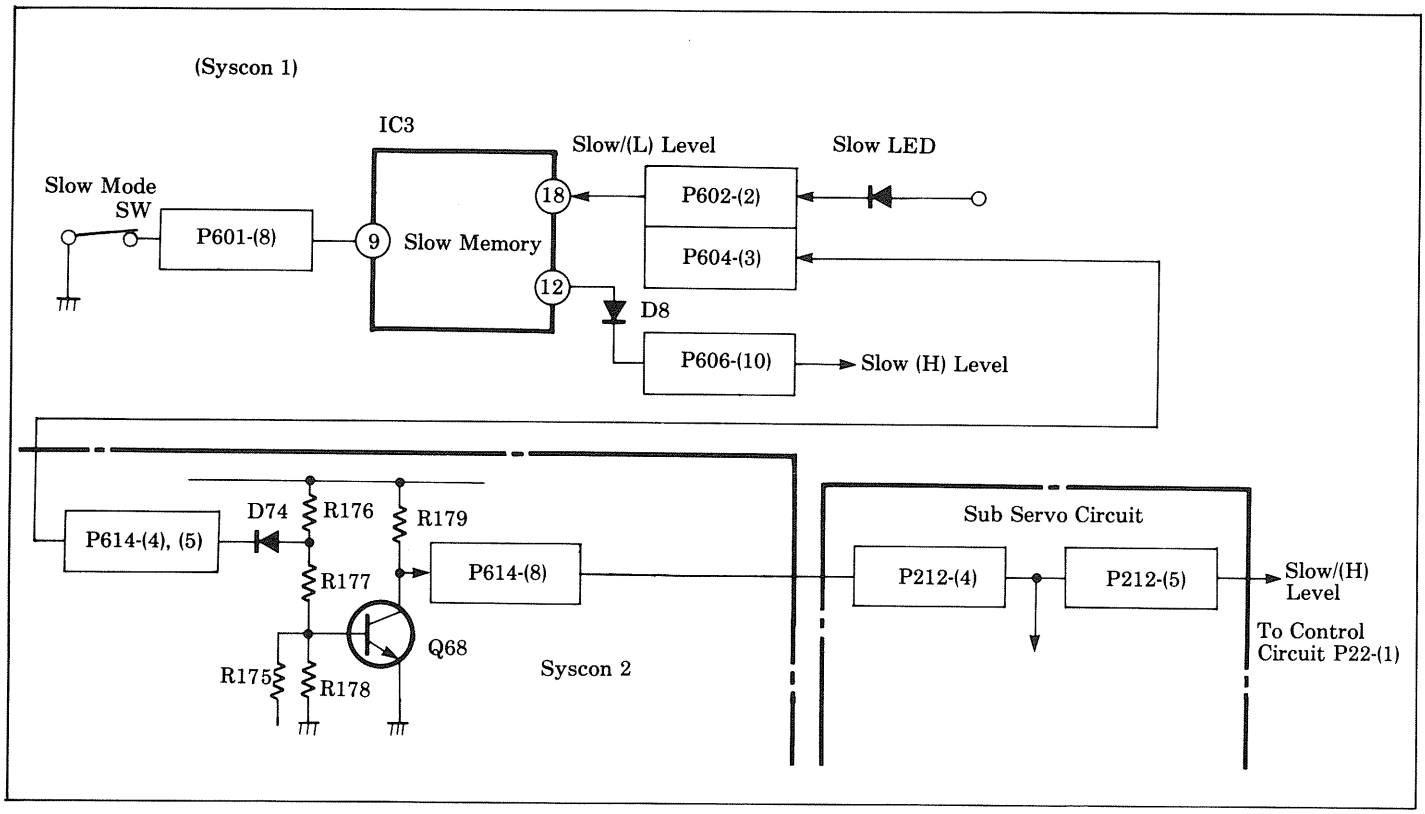



Fig. 31

When the slow sw is pushed, IC3-(9) on the SYSCON I changes to a low level. Then IC3-(18) turns low and IC3-(12) changes to a high level. When a high level appears at IC3-(12), loading action starts when unloading and has completed its cycle.

A low level signal at IC3-(18) lights the slow LED which is connected to connector, P602-(2). A low level signal at P614-(4)(5) turns Q68 off and a high level signal appears at the collector of Q68, which is supplied to the connector P22-(1) through P212-(4), (5) on the sub servo circuit.

## 6. B. Control circuit for slow mode.

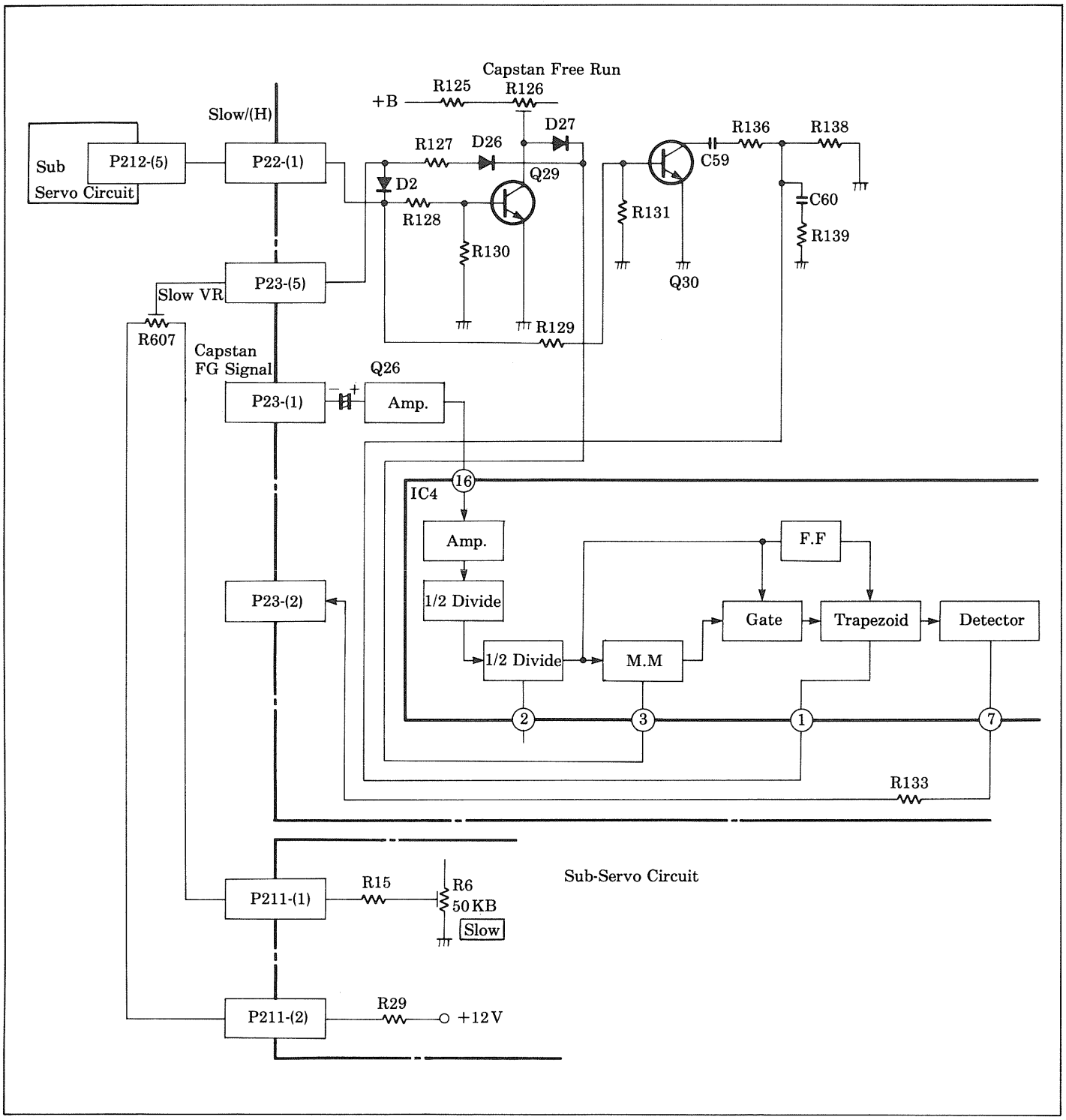



Fig. 32

In the normal speed mode the capstan FG signal at P23-(1) is divided by half within IC4. This 1/2 divided signal is supplied to a MM and a gate circuit. The time constant of the MM is determined by the cathode voltage of D27.

In a normal speed mode, P22-(1) is at a low level, so that Q29 is off and D2 (anode) is held low. In this condition a low level at D2 is supplied to IC4-(3) through D27 by R125 and R126 which is the capstan free running VR.

Q30 also is in the off position, so C60, R138, R139 at IC4-(4) determine the time constant of the trapezoidal wave form.

As mentioned above, the capstan motor is driven by a voltage which appears at IC4-7 through R126. In this mode, the capstan FG signal is 960Hz.

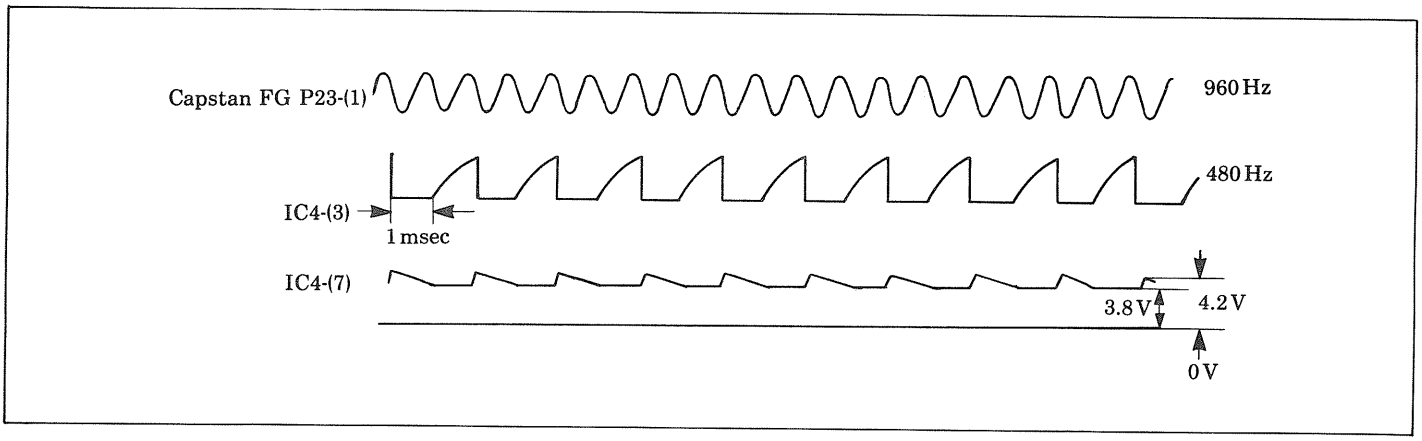
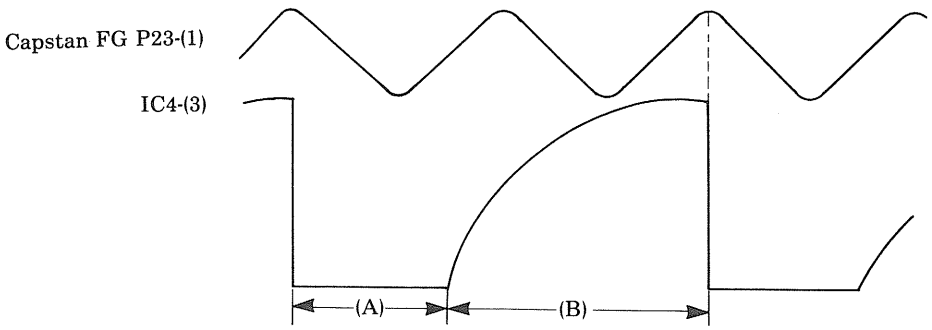



Fig. 33

In the slow mode, P22-(1) is open, so a high level signal at P23-(5) is supplied to IC4-(3) through D26. The high potential at P23-(5) varies by turning the slow VR, R607.

This voltage through R607 turns Q29 on by grounding the voltage which determines the R.P.M. of the capstan motor by R126. The voltage which is selected by the slow VR is supplied to IC4-(3) to determine the time constant of the MM, so that the capstan motor rotates according to the voltage which is selected by the slow VR.

Q30 also turns on to change the slope angle of the trapezoidal wave by adding C59, R136 to IC4-(4). The waveform at IC4 is shown in Fig 34.




(A)=Aprox. 6msec (Min.)~Aprox. 1004$\mu$sec
(B)=Aprox. 8.8msec (Min.)~Aprox. 140$\mu$sec

at P23-(2)

The capstan motor is driven by 1.1V~0.8V

Fig. 34

7. Moisture Sensor

The moisture sensor detects the presence of high humidity (moisture or dew) on the head cylinder base and shuts the unit off preventing the possibility of head and tape damage.

The moisture sensor itself is a special variable resistor which changes its resistance with ambient humidity. The sensor ranges in resistance from about 5 kohms at 90% humidity to about 50 kohms at 98% humidity. Its resistance is directly related to the ambient humidity.

Normally, without the presence of moisture, the voltage across the sensor is low because it is low resistance.

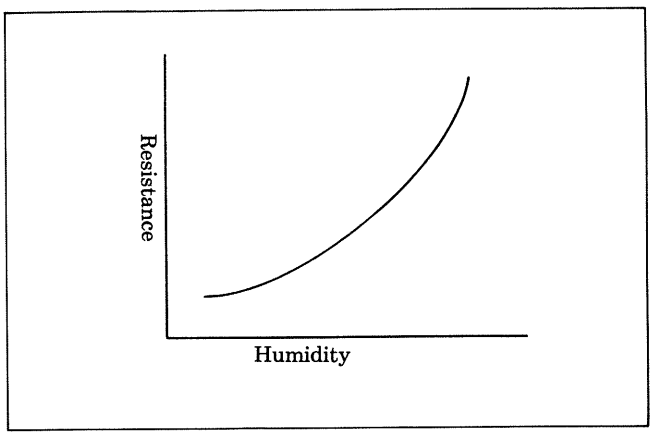



Fig. 35

Since Q59 has a low base bias, it is held off because of the voltage at its emitter developed by the current through Q60 and R156.

Q59 and Q60 is a Schmitt trigger. Q60 is forward biased by the current through R154. Q59 is reversed biased by the voltage at its emitter.

The voltage across the sensor must exceed the voltage of emitter Q60 (about 0.8v) before Q59 can start to conduct.
Once the voltage across the sensor rises enough to exceed Q59's emitter voltage by about 0.8v, Q59 will conduct. At this point, (the base voltage of Q60 decreases as its emitter voltage increases) Q60 quickly turns off - this causes the Schmitt trigger to reverse its state.

Now, with the collector of Q60 high, Q61 turns ON, generating a high level signal (1) and lighting the LED (2). This condition will be maintained until the moisture sensor has dropped in resistance enough so that the developed voltage across it no longer exceeds the emitter voltage of Q59.

Please note that for the circuit to detect moisture the base of Q59 must exceed the voltage across R156, 0.8v.
R156's voltage is determined by R156 and R155. This sets the threshold for moisture detection.

If the moisture sensor is shorted, no moisture could ever be detected. If the moisture sensor is removed or opens, the circuit would trigger and the unit would stop.

1. A High level signal at the Emitter of Q61 is applied to D18 for cutting D17 off. So the complete voltage would be supplied to the capstan motor.
When the capstan motor is rotated (through R31, D16) rapidly, the tape can be prevented from sticking to the cylinder head. Thus tape damage is avoided.

2. At the same time, a High level signal is applied to pin 15 of IC4 on the System Control I circuit through R69 and D33.
A high level signal at pin 12 of IC4 will start Eject action.

8. Still/Pause Mode

When the Still/Pause button is pushed during the play mode, a low level signal is supplied to the base of Q12 which turns off. So a high level signal at the collector of Q12 enters the T type flip-flop, which consists of Q13-Q16. Therefore, a low level signal or Still hold signal appears at the collector of Q17. In another way, this low level signal also produces the Still, X2 mode. The slow circuit in the servo control P.C.B. through D32 and connector P607 (6) will also stop the capstan motor.

Now, a high level signal at the collector of Q12 goes into the base of Q14, Q15 through R54, R56 to turn Q14 off and Q15 on. If Q15 turns on, a high level current flows into the base of Q13 to turn it on. Then, the low level signal at the collector of Q13 turns Q16 off, and Q17 on to keep the low level signal at the collector of Q17. This low level signal is used to illuminate the LED for Still/Pause and also produce the still hold signal for stopping the capstan motor. In this case, after pushing the Still/Pause button, C22, 220μF starts to charge through R61-1.5M.ohm The pause button will be released automatically if this mode is held for 3-5 minutes. If C22-220μF is saturated, a high level signal enters IC8 (3). This low level output through IC8(2) and D37 turns Q8, Q7 on. So Q7 performs as a stop sw. Because of this, it is connected in parallel with the stop sw.

SUB LOADING CIRCUIT

The subloading motor, M601, will begin its operating cycle when the cassette is inserted and the cassette holder lowered.

When a cassette is inserted and the cassette compartment is lowered, and S609 and S613 close. As a result of it, a high level appears at IC4-[3]. This high level also appears at IC4-8 to turn Q29, Q31 and Q32 on. Now +20V flows to the subloading motor through Q32, P616-[1], P616[2] and Q31.

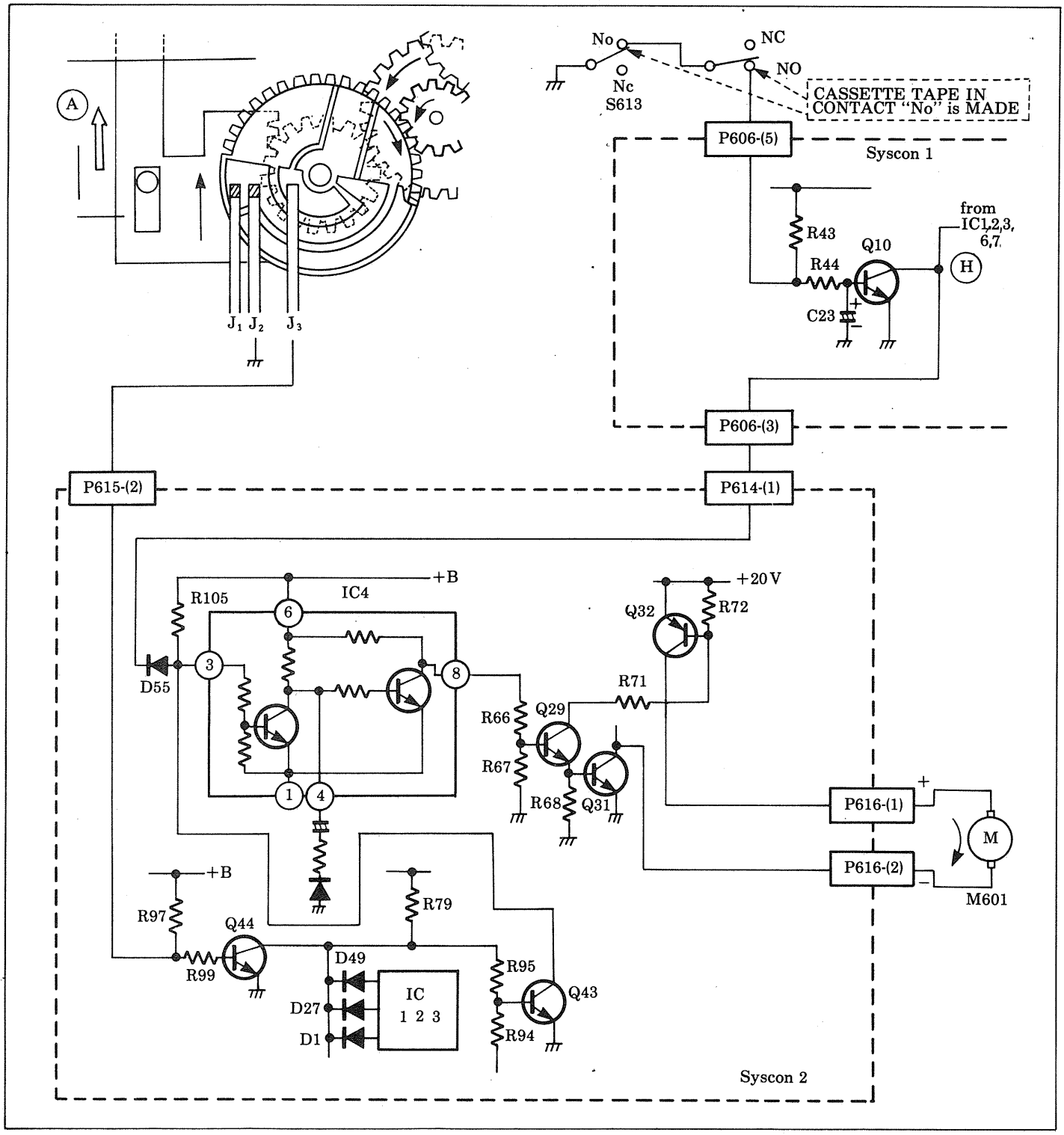



Fig. 36

TO STOP THE SUB LOADING MOTOR

When gear No.4 reaches the position as shown in Fig.37, J3 is grounded so that Q44 turns Off and Q43 On.
Therefore, IC4-[3] becomes a low level, so the motor will be stopped.

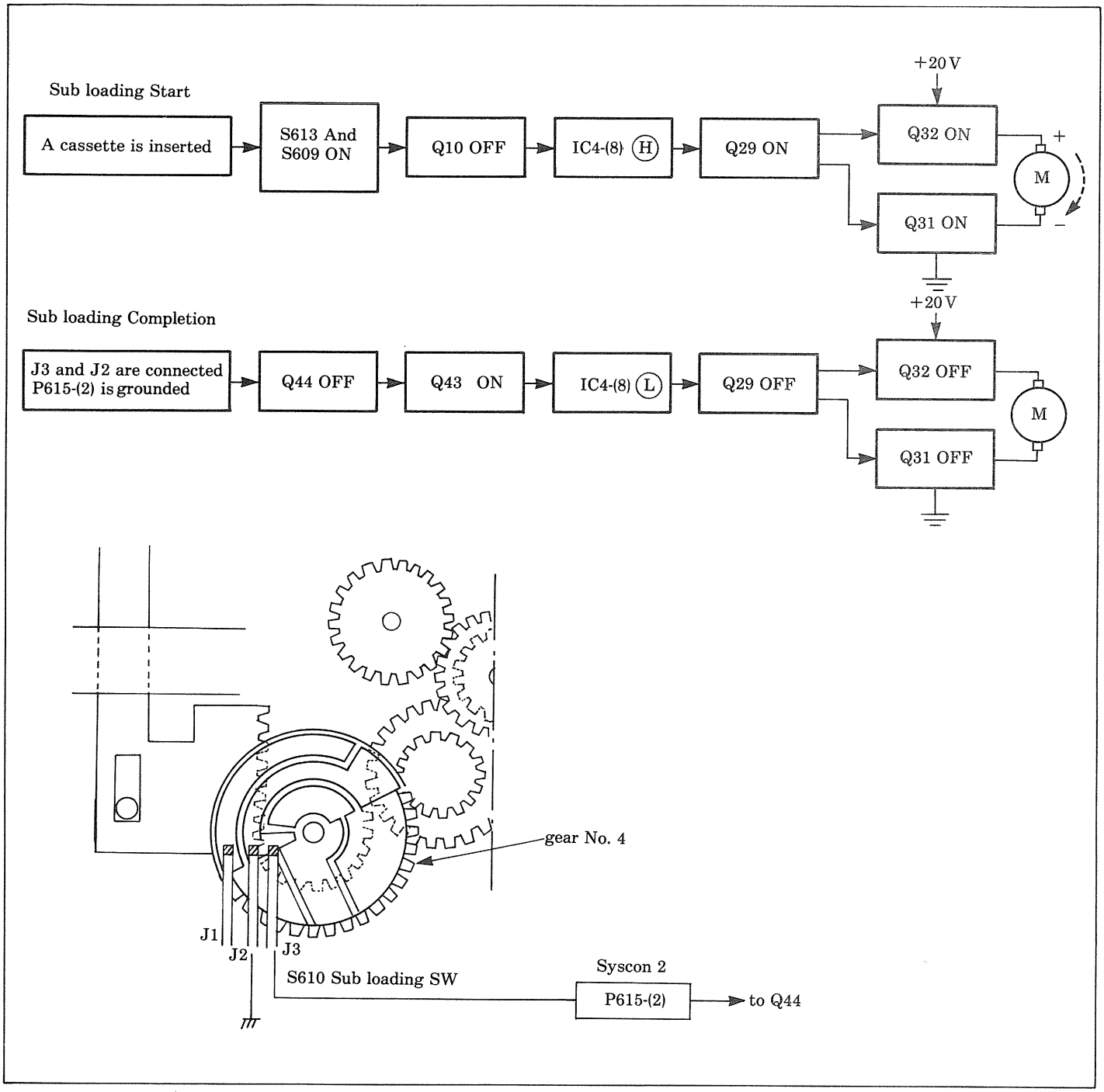



Fig. 37

Rewind/Repeat

The tape memory switch can be used to automatically stop tape rewinding at the place where the tape counter digits read "999", or repeat the playback between the begining of the tape and the place where the tape counter digits read "000".

Rewind Position

When the tape is rewound by pushing the rewind button after playback has finished, the tape will then stop when it reaches counter position (999).
The tape can then be played back again.

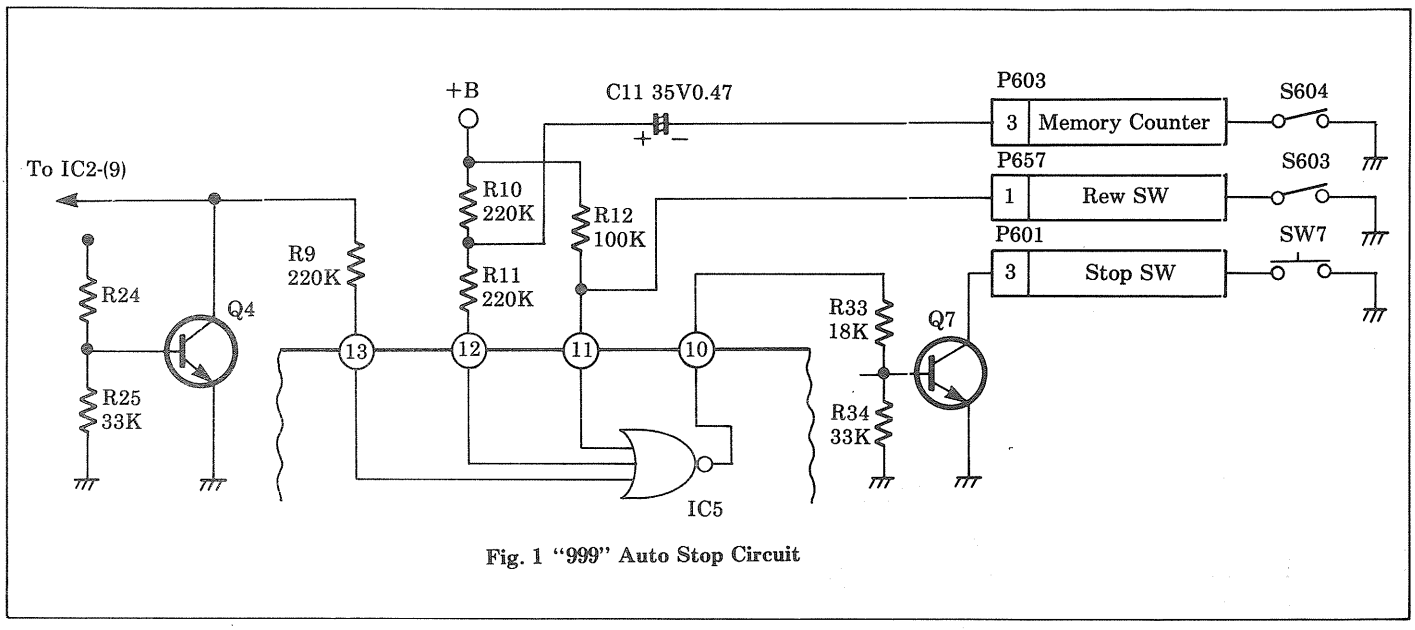



Fig. 1 "999" Auto Stop Circuit

Fig. 38

This circuit usesathree input nor gate that is located within IC5. Tape will be stopped automatically when conditions exist where three signals coincide at the input of Pins 11, 12, and 13 of IC5 with a low level.

1. Pin 11 of IC 5 is low when the "REWIND" position is selected -SYSCON-1.

2. The tape counter reset button is pressed to "000" so a low will appear at Pin 12 of IC5-SYSCON 1-.

3. The deck is in the rewind mode to produce a low for Pin 13 of IC5-SYSCON 1-.

Thus, a high appears at Pin 10 of IC5-SYSCON 1- which turns Q7 on. Q7 is connected in parallel with the stop switch and therefore the tape will stop.

Repeat Position

When the tape memory switch is set to the repeat position, IC5 Pin 1 is held low -SYSCON 1-.

IC5 Pin 2 is low during playback. When the memory counter detects the "999" position, a positive spike appears at Pins 3, 4, and 5 of IC5 which is converted to a low by the nor gate within IC5. A low level is then supplied from Pin 6 to Pin 8 of IC5.

Therefore, a high appears at Pin 9 to turn Q4 on to activate the rewind mode automatically.

When the beginning of the tape is reached, a high appears at the connector P606-2 - SYSCON 1- from the take-up photo sensor detection circuit. Thus ,the mode changes from rewind to play through Q6.

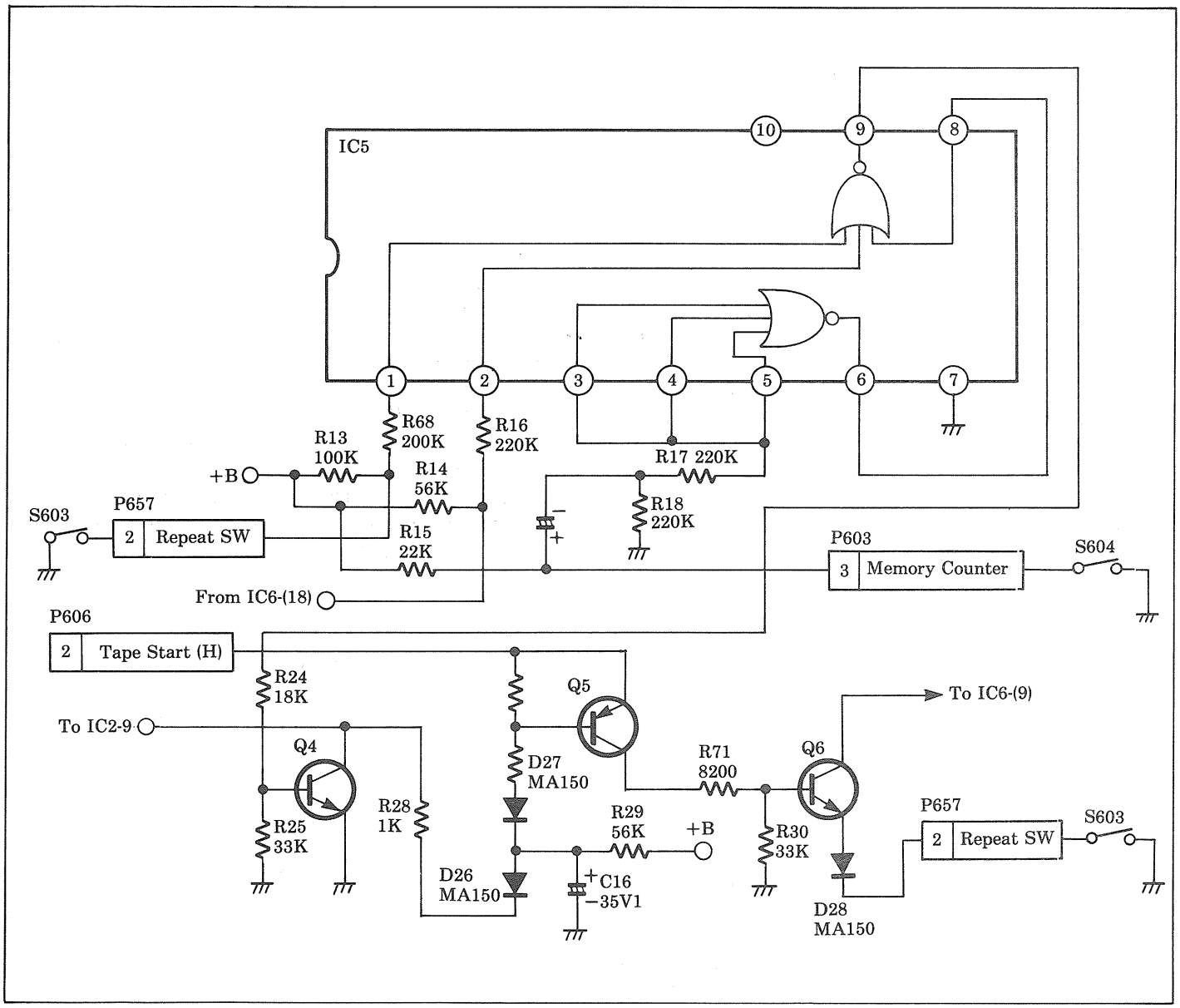



Fig. 39

SERVO SECTION

CYLINDER Servo Basics-Record and Playback

In order to place video tracks on the tape in a specific stable pattern, the video heads must be locked to the incoming video signal. Therefore, it is necessary to have the head cylinder motor servo-controlled a sketch of the video tracks on the tape is shown in Fig. 40.

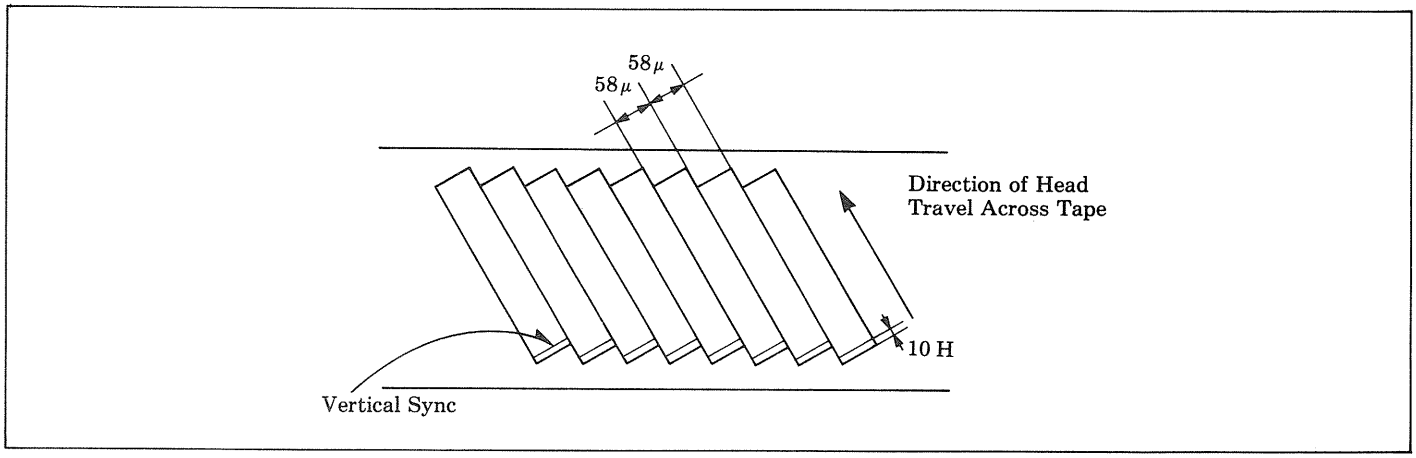



Fig. 40

Servo action assures that vertical sync occurs approximately 10H (horizontal lines) from the beginning of each track. Since vertical sync should be placed at the same spot on every track, it is necessary to lock the servo to vertical sync. Since there are 2 heads on the cylinder, and the vertical sync rate of a color video signal is 59.94Hz, the cylinder spins at (59.94/2) revolutions persecond which is 1978 RPM althouth 1800 is used in this description.
The speed of the cylinder, then, must be very close to 1800 RPM at all times. To make sure that vertical sync is recorded about 10H into the track, position must be locked. Therefore, both speed and phase servo circuits are necessary. For speed control feedback, the servo circuits utilize position detection signals which are generated in the drive motor. This sinewave is amplified and shaped to make a square wave. This square wave is then applied to a flip flop (FF).

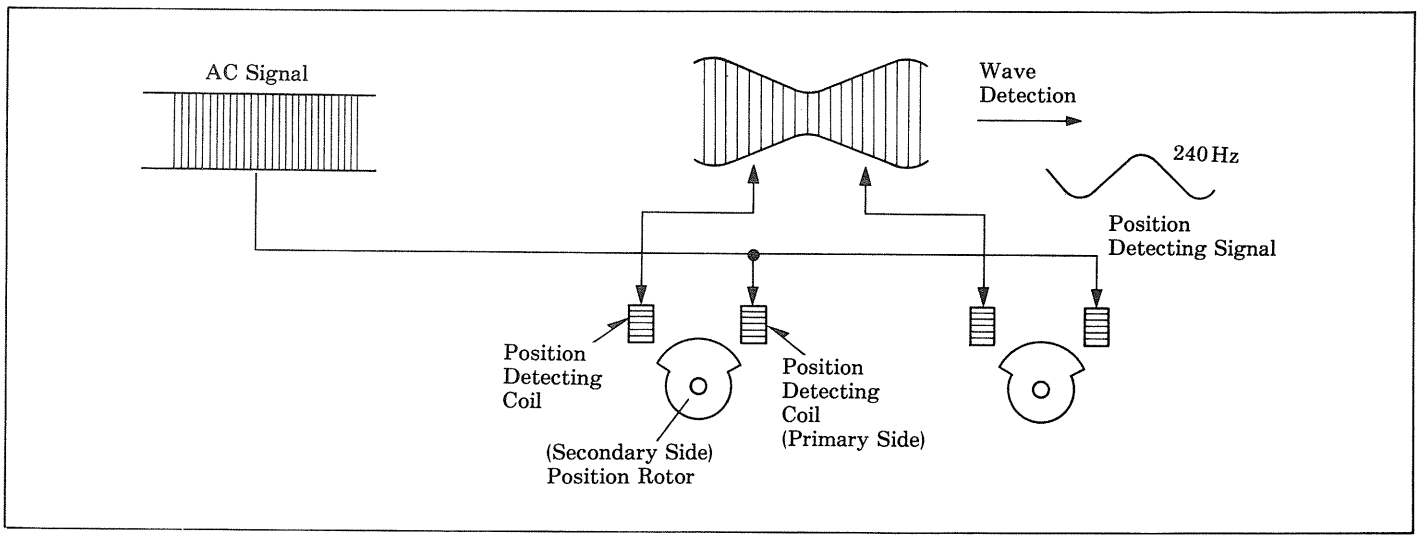



Fig. 41

The output square wave of the FF is sent two ways: one signal is inverted and sent to the GATE circuit, and the other is applied to a MMV. The MMV output square wave is then applied to the GATE circuit.

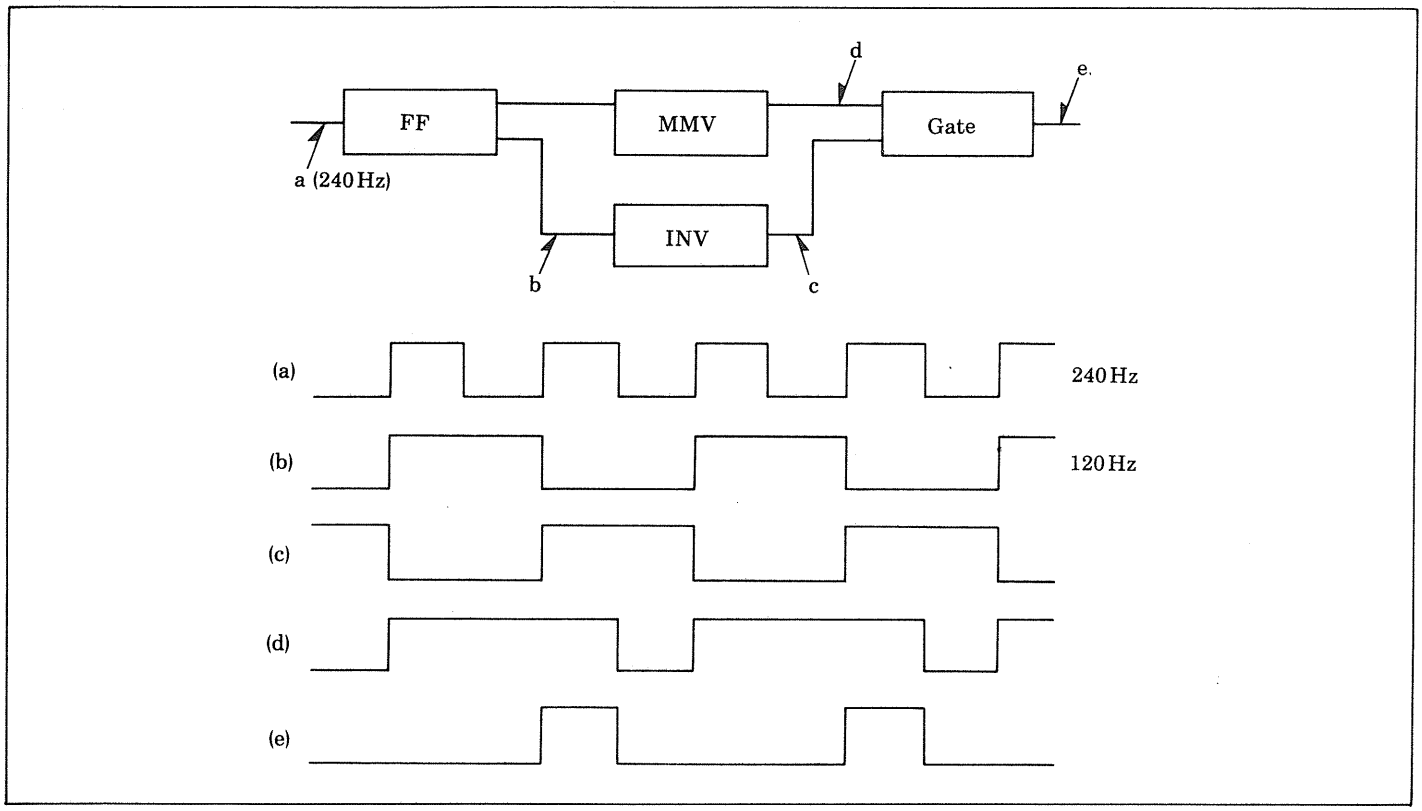



Fig. 42

The gated signal (e) is converted to a trapezoidal wave. At the same time, the gated signal (e) and output of the MMV are gated to make square wave.
Those two signals are sampled.
The output of the MMV is a square wave of variable frequency depending on the speed of the cylinder.

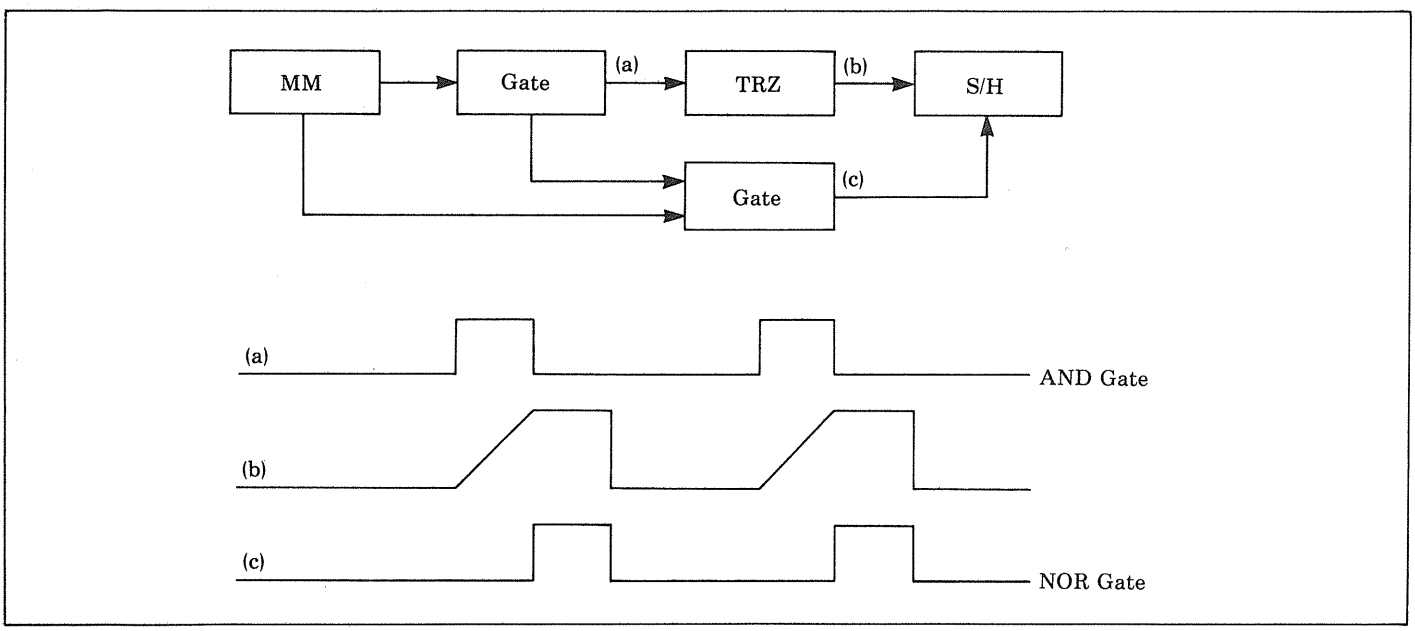



Fig. 43

This sample and hold output signal is filtered to obtain a DC voltage. This DC voltage is used to control the speed of the motor, keeping it at the desired speed because it varies inversely with speed.
To achieve phase control, the cylinder utilizes a PG coil which will give both positive and negative going pulses, each at 30Hz.
The cylinder motor 2 magnets attached to the flywheel.

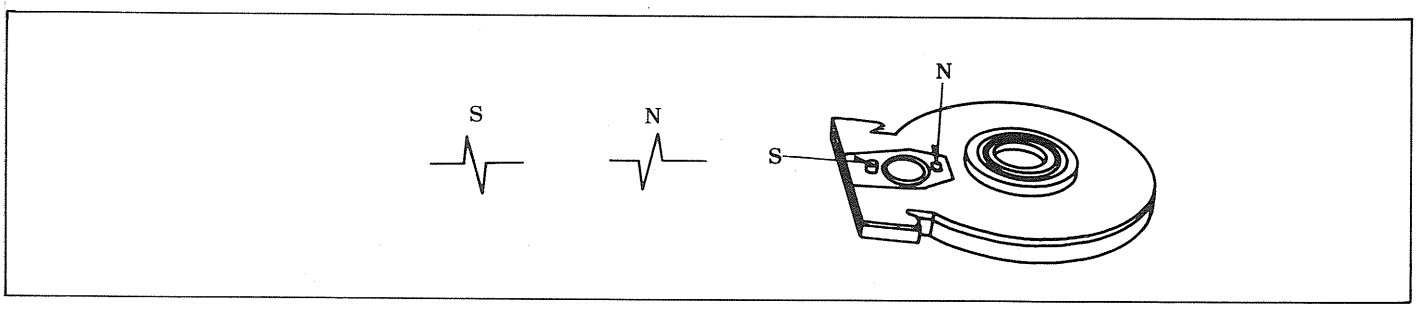



Fig. 44

As the motor spins, the magnets alternately pass over the coil and since the magnets are seated one S pole and other N pole outward bipolar PG pulses are produced.

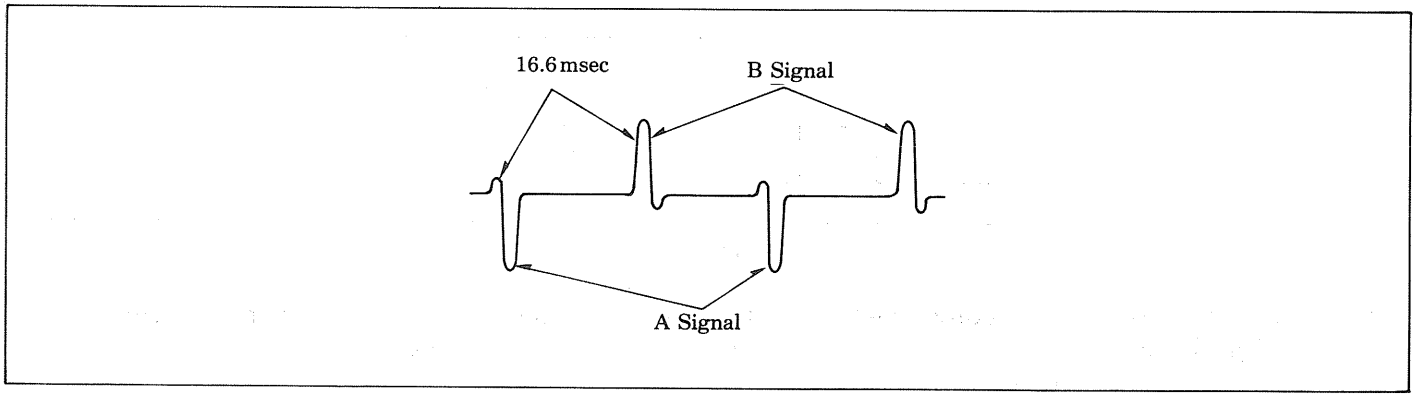



Fig. 45

Assume that the "A" magnet passes the coil just when the A head starts to scan the tape, and further assume that it produces a negative pulse(A) which at the moment occurs the A head is starting to scan the tape. Of course, just the opposite case would occur for the B head. The polarity of the pulses and their timing reflect head position.
Next, the PG pulses are separated and each pulse is used to fire a MMV. Then each MMV output is applied to a flip flop.

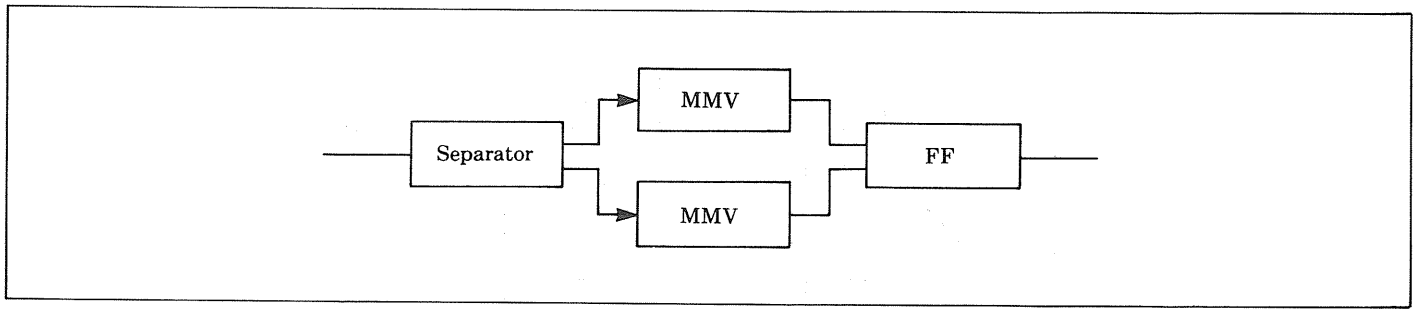



Fig. 46

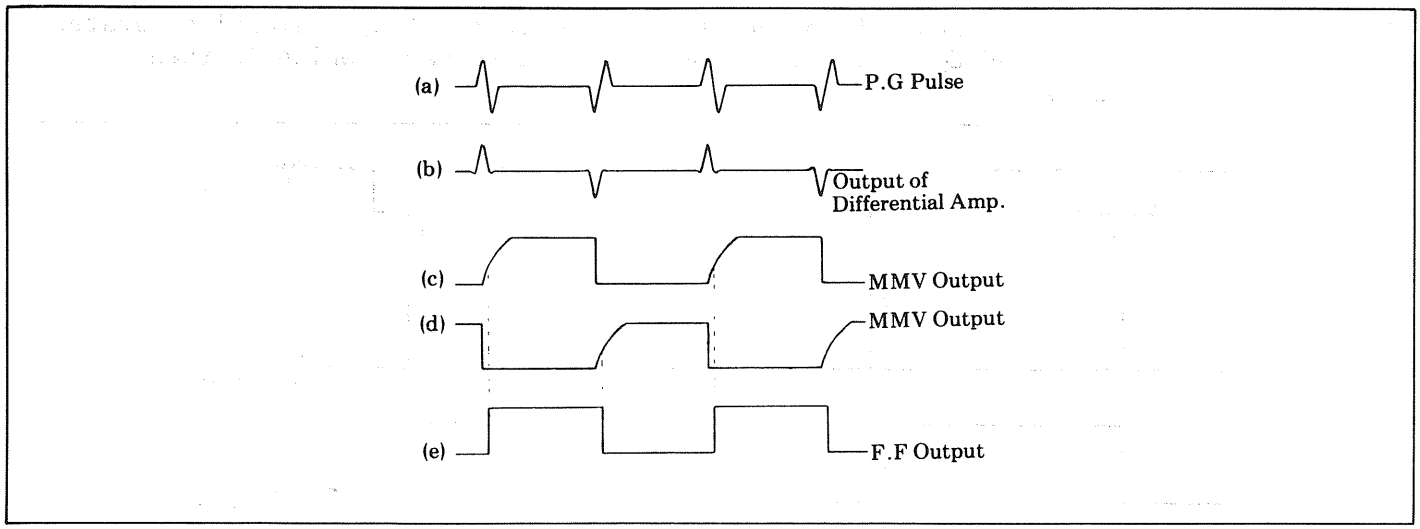



**Fig. 47 Flip Flop Operation**

Because of the arrangement, we know that wherever the FF output square wave goes low, the A head is starting it's sweep.
This square wave output (FF output) is used in two places. It is used as playback head switching signal, and it is used in phase control.
For head switching, when the square wave goes high, the "A" playback channel is turned off (when the square wave goes low, the "A" head is starting it's sweep.) and conversely for the "B" channel.
The second use of the square wave is phase control. The first step in phase control is the conversion of the square wave into a sampling pulse.
The head switching pulse is applied to a MMV and the output of the MMV is then gated. This sampling pulse will be compared against a trapezoid.

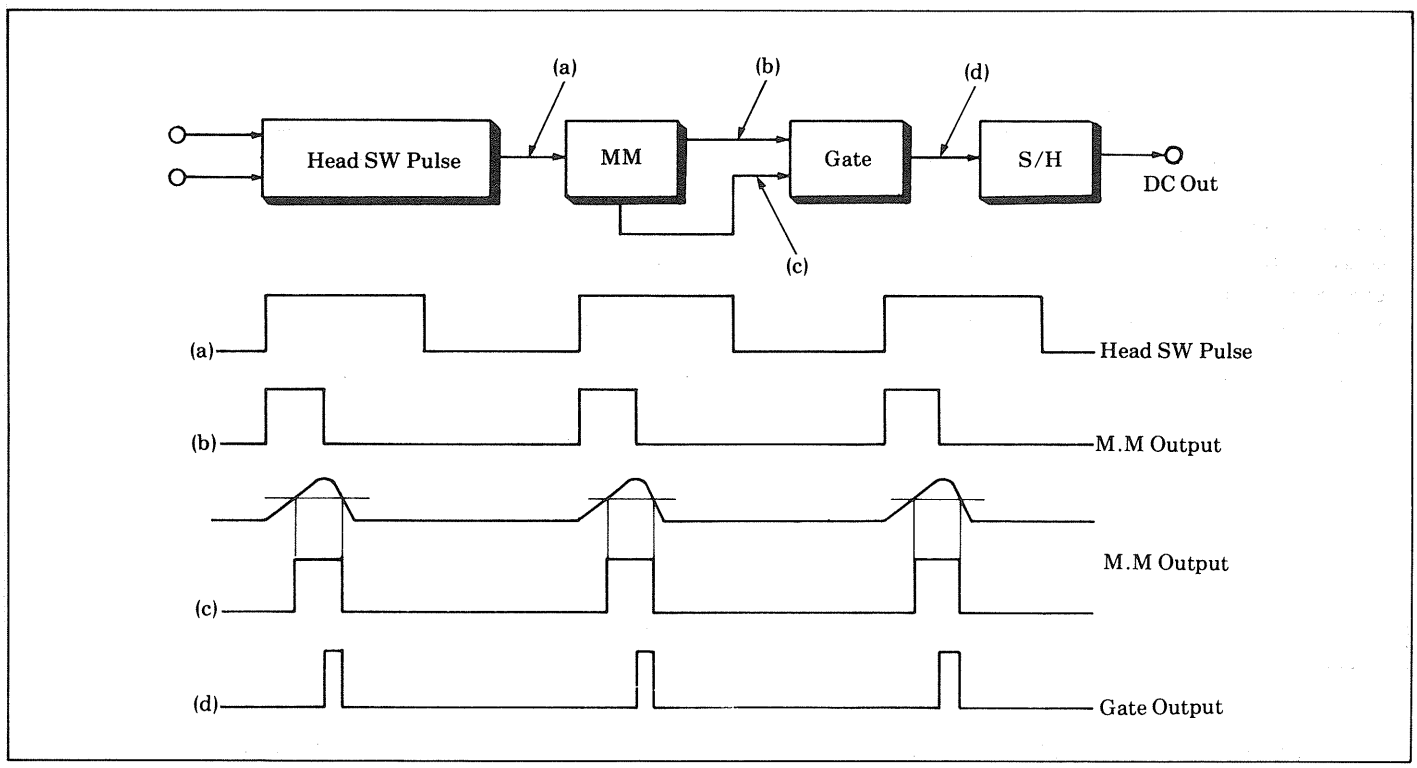



**Fig. 48 Gated MMV**

The trapezoidal signal is formed from the input video vertical sync signal separated from the video and counted down by half to obtain a square wave, which is then converted to trapezoid.

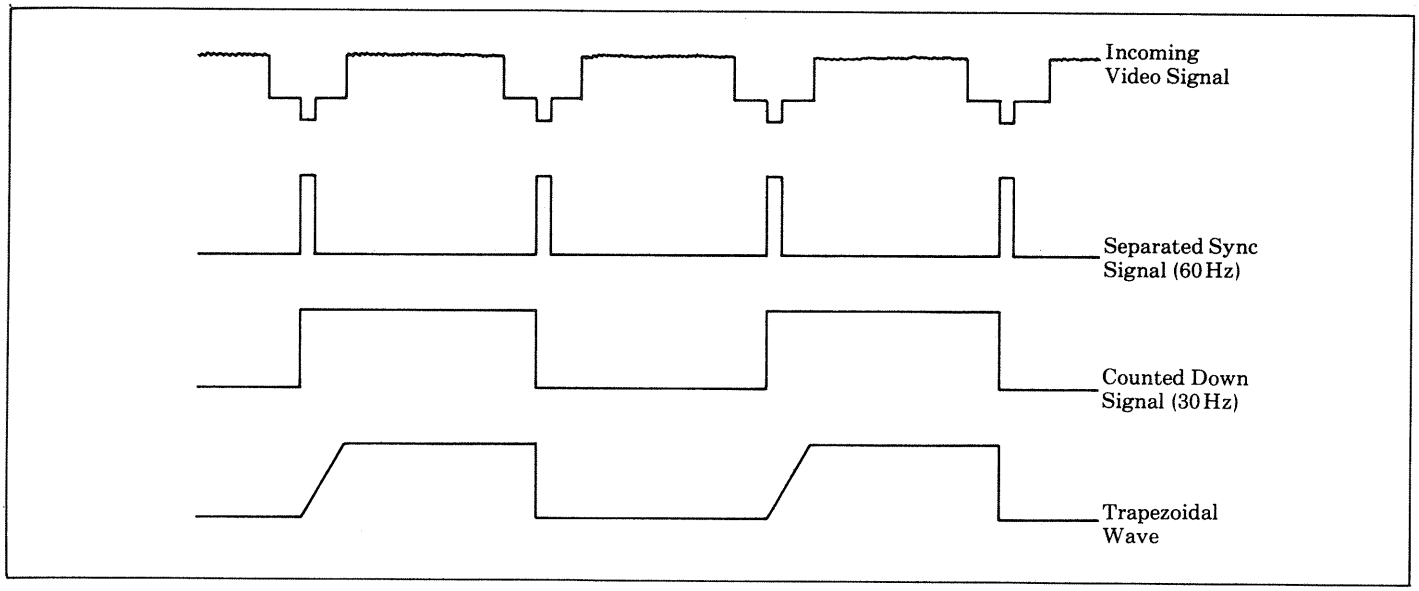



**Fig. 49 Trapezoid Wave**

Assume that the trapezoidal wave and the sampling signal align as if viewed on an oscilloscope. If a voltage sample wave taken of the trapezoid ramp at the moment of the pulse, the sample might be arbitrarily called X volts.

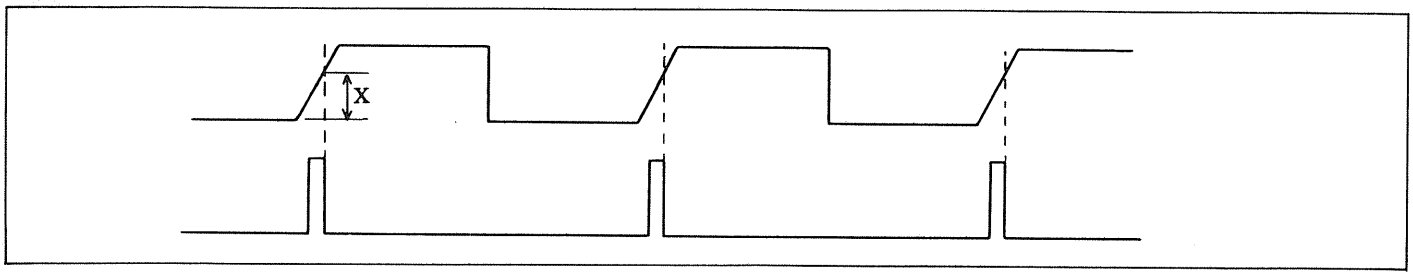



**Fig. 50**

Shoud the head cylinder start to speed up, the frequency of the sampling pulse would increase, and the waveform would "shrink". As viewed on an oscilloscope, the sampling pulse would pull to the left, moving the intersection DOWN the ramp. Sampling the ramp at this point would yield a lower voltage (-X).

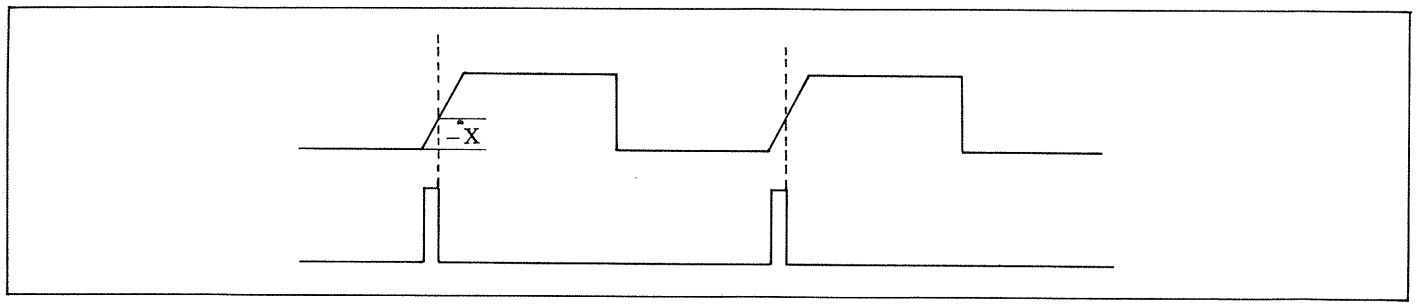



**Fig. 51**

Conversely, if the cylinder started to slow down, the sampling pulse would expand to the right, intersecting further up the ramp, which would yield a voltage (+X).

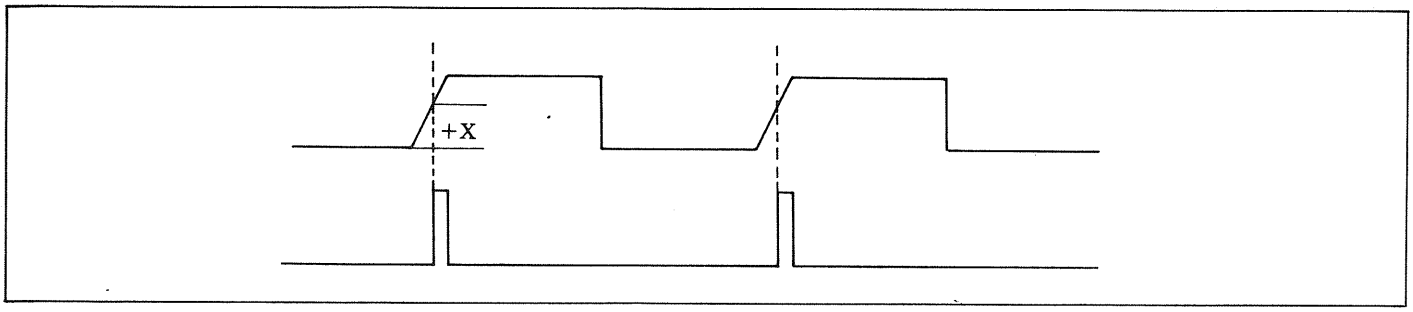



Fig. 52

One can see that as the pulse samples the trapezoid, a varying output voltage will result according to their relative positions. The output voltage could be used for fine speed control the motor. This is exactly what is done for phase control in recording. Note that the range of phase control is limited to just the rising ramp. If this is the design the speed servo keeps the cylinder at the right speed and the phase control is a limited range or fine speed control.

To reiterate, there are two actions used in cylinder servo;

(1) Speed Control (Course)
(2) Phase Control (Fine)

Simplistically the only change of operation between the record and playback mode is the source of the reference signal. In record the input V sync signal was used. In playback, there may not even be an input connected, so a 60Hz signal, counted down from a 3.58MHz crystal oscillator is used. Then, as described in record, the 60Hz signal is further counted down to 30Hz and is used to form a trapizoid and the process is repeated.

A question might arise that if the cylinder locked to the incoming V sync for recording, how can any other steady reference be used for play and be expected to give good picture? Remember the capstan servo has yet to the considered, and, in conjunction with the head cylinder servo it will take care of playback.

There is one more function associated with the cylinder servo operation which must be mentioned and that is the control track pulse signal (CTL). In the record mode, the V sync is applied to an MMV, effectively divided by 2 and sent to control head.

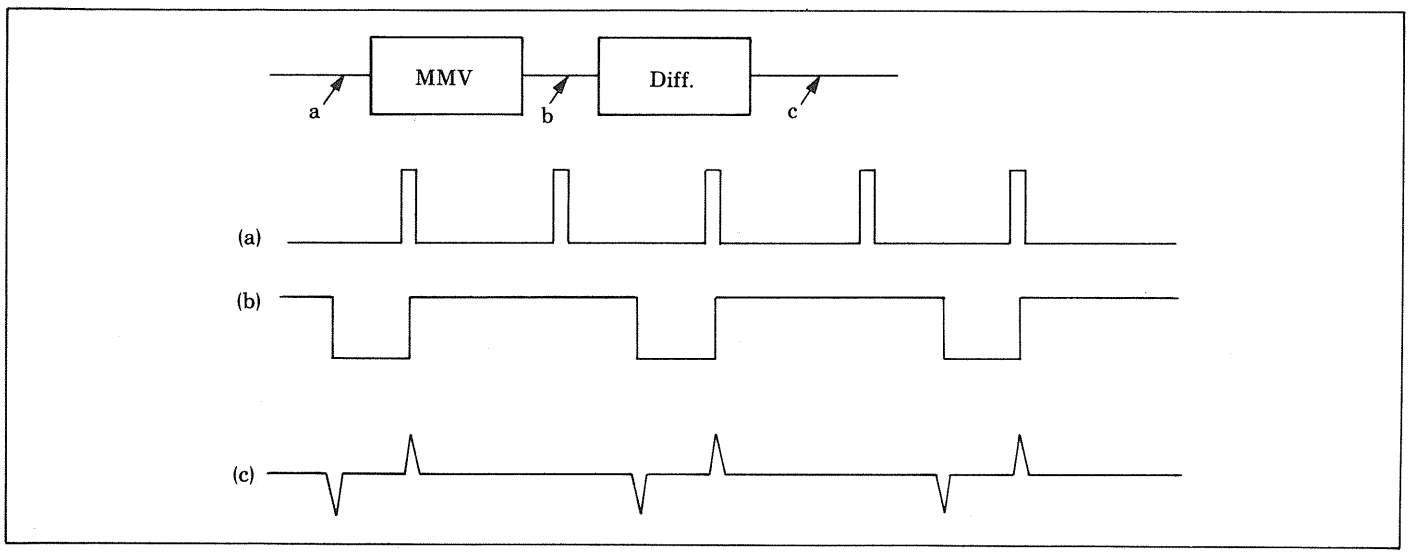



Fig. 53

When the A head starts its sweep, a control pulse will be placed on the tape. This control signal is read off the tape in playback fed to the capstan servo circuit. When the system receives a playback control pulse, we know that the A head should be scanning the tape.

Capstan Servo Basics-Record and Playback

It is beneficial to have read the Cylinder Servo Section because many of the same descriptions apply, and are not repeated. Knowing that the head are locked up to the incoming video signal for recording, it is desired to have the tape move past the video head at a very steady speed.
The stable capstan speed will insure even spacing of the tracks on the tape, but tied to the cylinder servo to assume consistant pattern placement.
Therefore, the capstan motor governs its own speed, but phase locks to the cylinder.
The speed control is of the same type as was used in the cylinder circuit except for the generation of the FG pulse. Capstan FG signal is used for speed control and is formed by two concentric gear shaped pole pieces, one stationary and one rotation. The FG output is a sinewave of 960Hz in the normal (2 hours) mode and 1920Hz in the X2 mode.
The sinewave of the FG output is sent through an amplifier circuit and shaped to square wave. The square wave is then applied to a FF and divided by 2. (In the play X2 mode, the second FF is used to divide by 2 again.) The 480Hz square wave is formed into a trapezoid in either case.

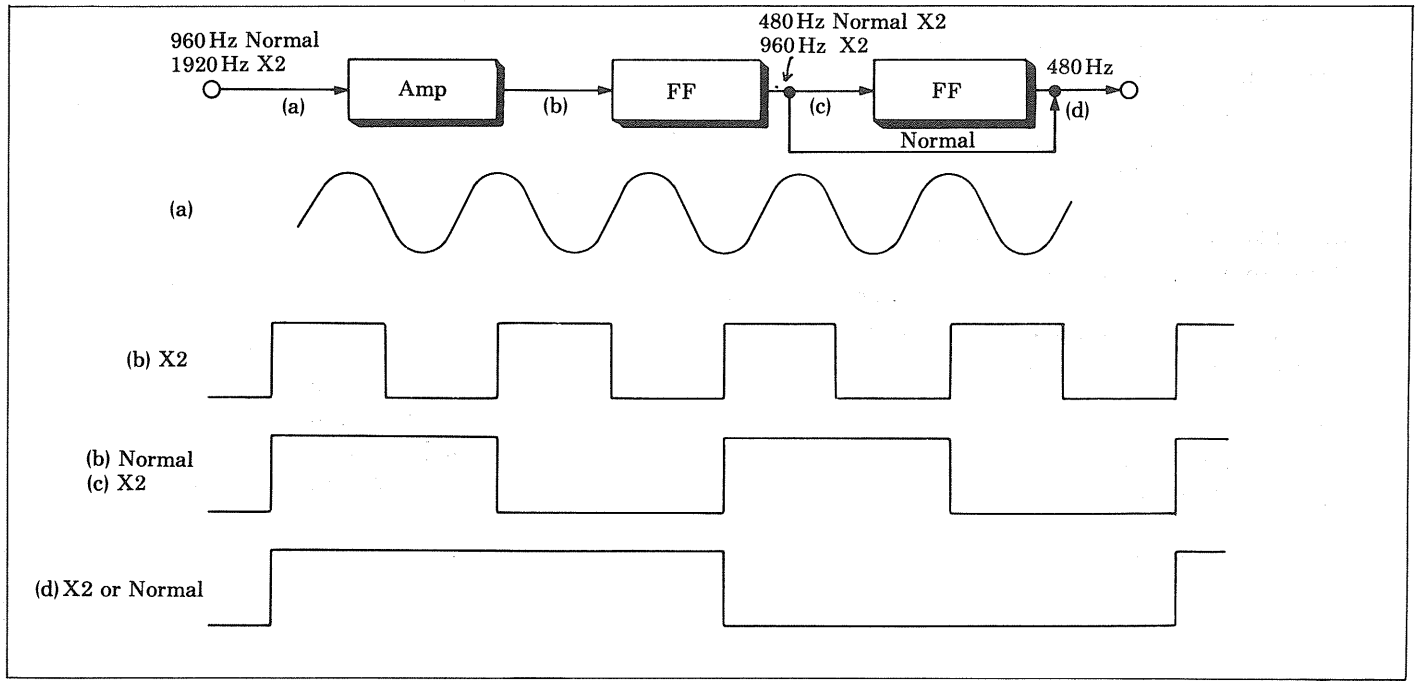



Fig. 54 1/4 Countdown

Since in the record mode the capstan is a round shaft which must turn at a constant speed, with no special place in time (as the heads hone) the capstan phase signed (PG) in record is simply devided FG.
Phase control for the capastan is similar to the cylinder; the trapezoid is made by the V sync and sampling pulse made by the divided capstan FG, counted down to 30Hz.
Note that the capstan PG signal samples the trapezoid on its rising slope, and since the capstan PG pulses are 30Hz, they sample the trapezoid one very ramp.
In playback, the phase control is the playback of the CTL pulses put on the tape in record. These difine the position of the video tracks.
There is a user adjustable control active during play, tracking, which can change the position of the sampling pulse on the trapezoid.
When this occurs, there will be momentary phase shift before lock up is regained, this phase shift will change the sampled voltage applied to the capstan shift will speed it up or slow it down momentary before it reverts to normal speed, slightly shifting the relative position of the tape for best playback by centering the video tracks.

Cylinder Servo

Detailed Description

PG AMP

Since the PG signal produced by the head cylinder pick up coil is too low in amplitude to be used directly, it must be amplified.

Q6 provides the necessary gain for the PG signal.

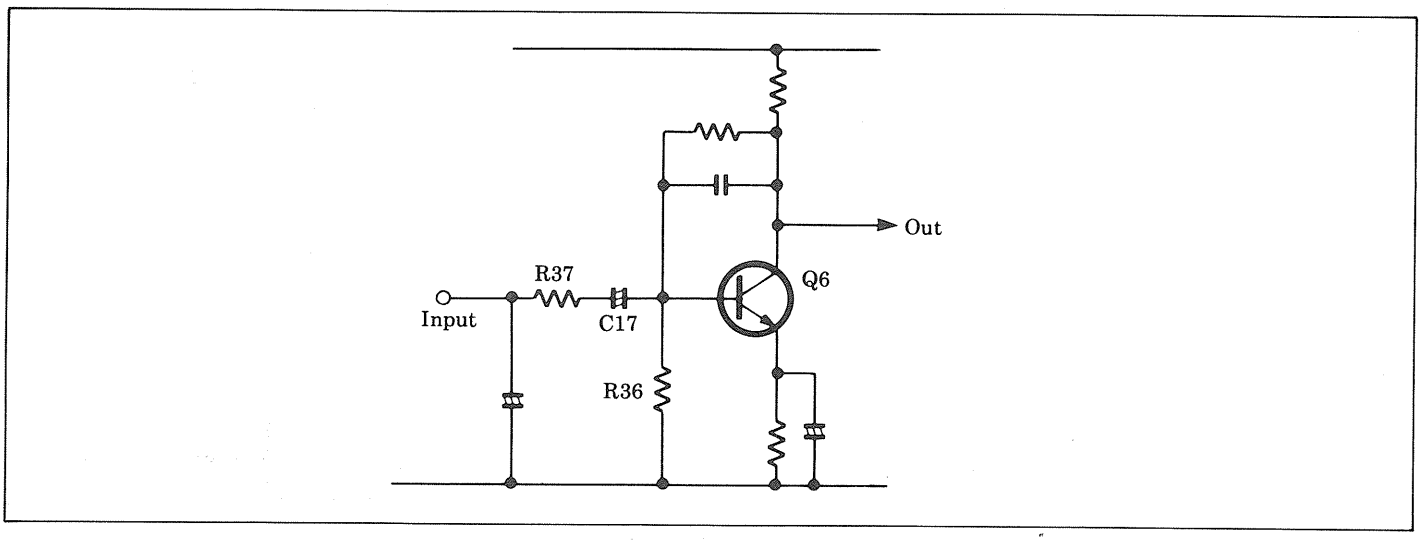



Fig. 55 P.G Amp

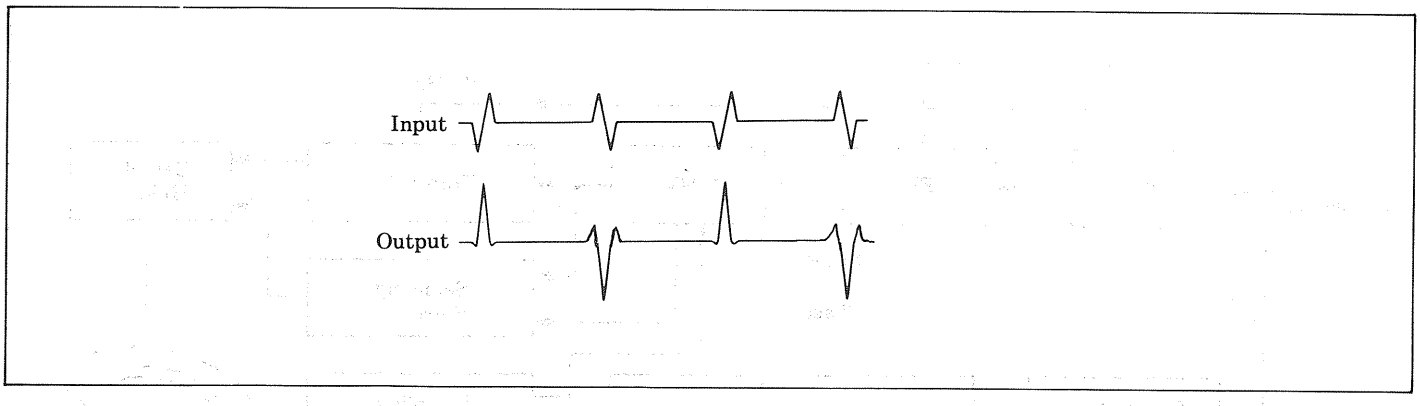



Fig. 56 P.G Pulse

Positive/Negative Pulse Detector

The PG pulses are used to trigger the two monostable multivibrators (MMV), which in turn generate a square wave by setting and resetting a flip flop (all within IC1). One MMV will only trigger from a positive pulse and other MMV will only trigger from a negative pulse, so the PG pulses are separated by the bias on Q6 and the RC networks which follow.

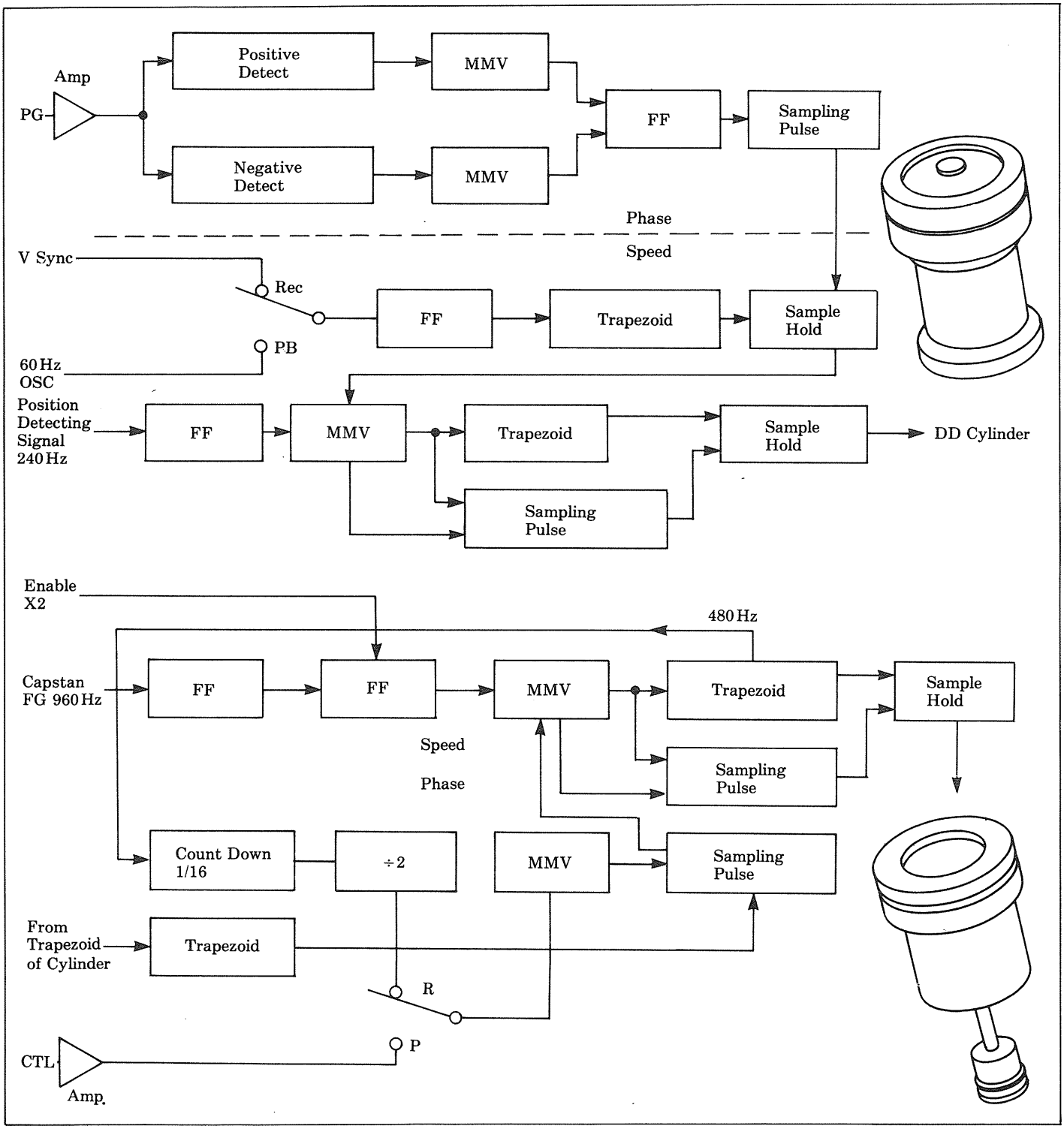



Fig. 57

The positive pulse will be detected by C9 and R24, and the negative pulse will be detected by C8 and R23.

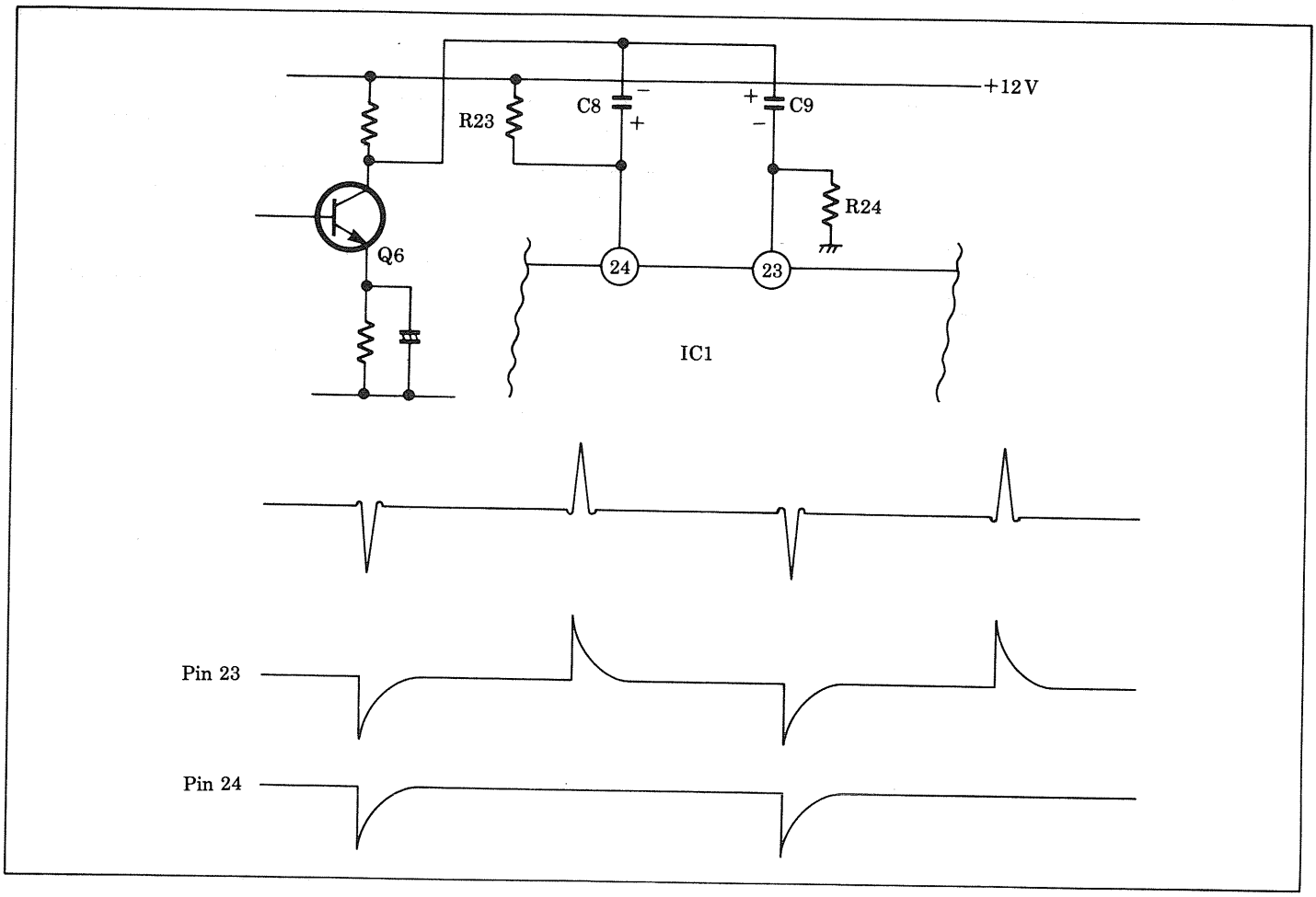



Fig. 58

Square Wave Shaper

The PG pulse generator in the head cylinder is made by the 2 magnets, which ideally should be exactly 180° apart. Since the PG pulse will not produce a perfect square wave and their location on the flywheel is not exact, the detected PG Pulses are sent to each MMV so that they are indepepently adjustable shutted in time to appear at the right monment, and fed to a FF to produce a square wave.

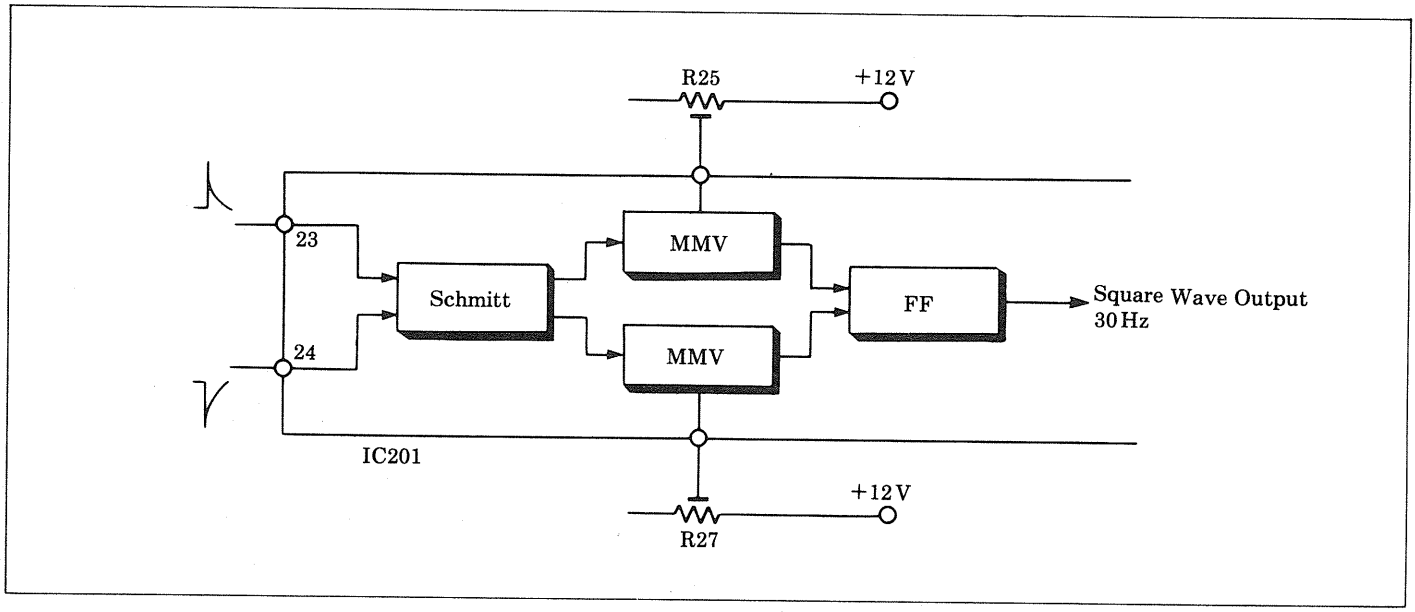



Fig. 59 Square Wave Shaper

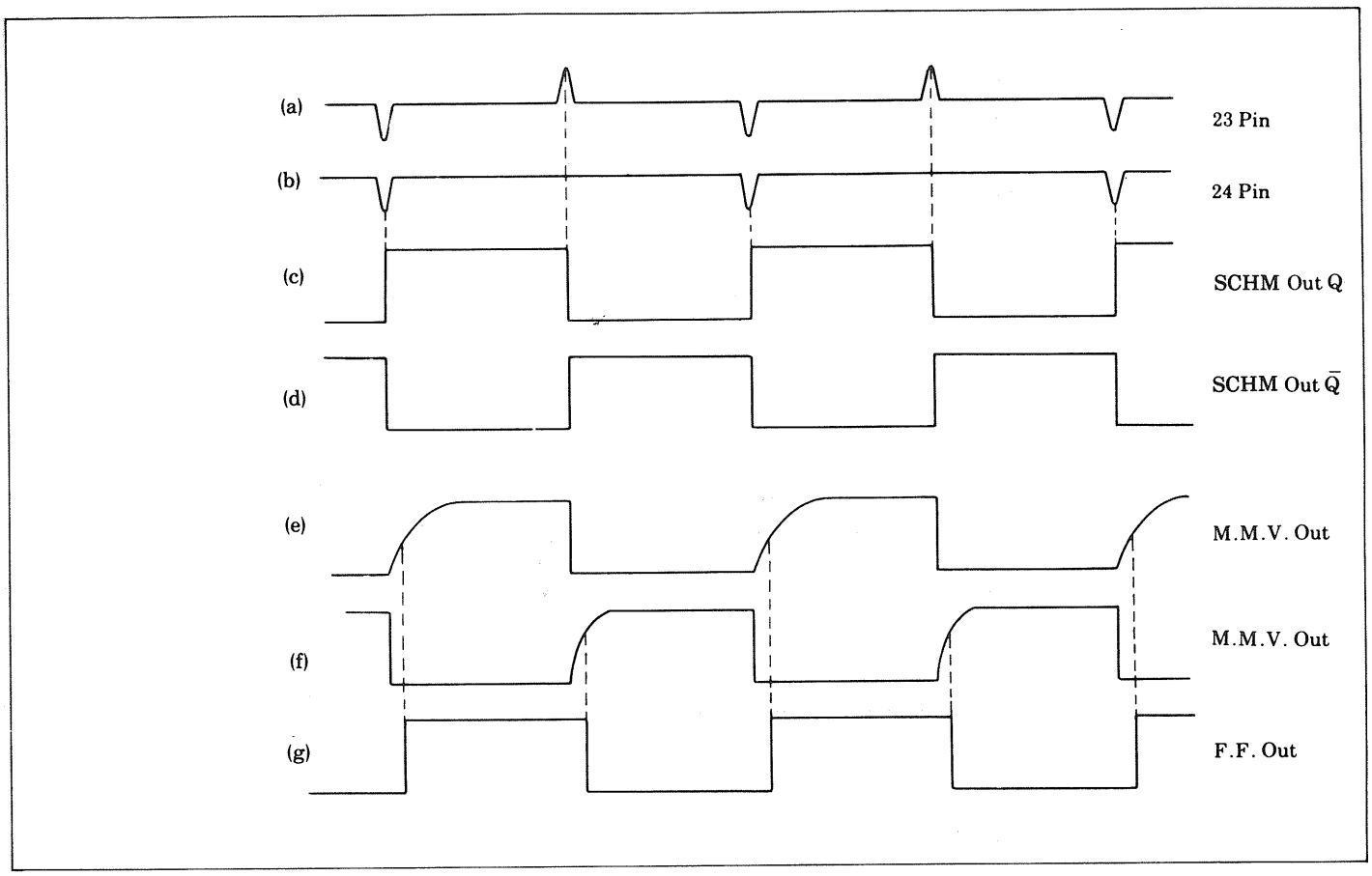



**Fig. 60 Square Wave**

Sampling pulse

The FF square wave and one MMV output are gated then applied to MMV. The output is in turn gated.

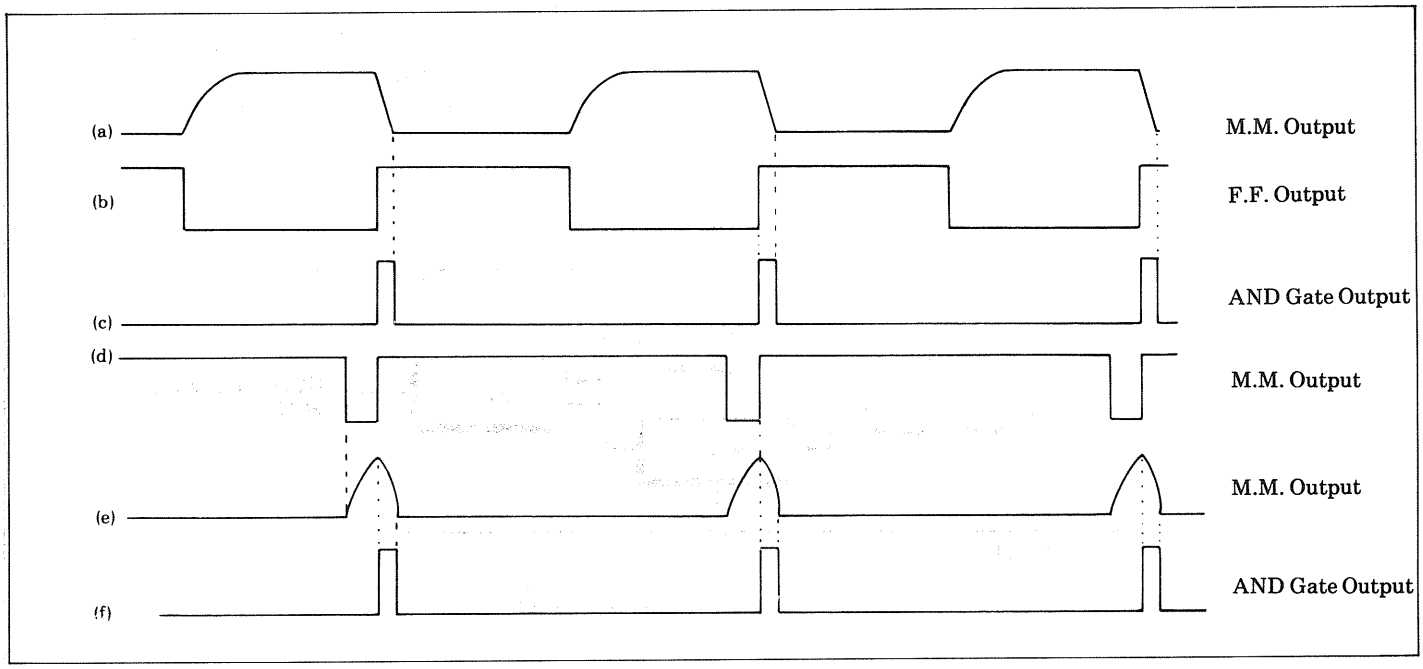



**Fig. 61 Sampling Pulse**

Sample and Hold

The sync is converted into a trapezoid waveform and sampled by the sampling pulse just described.

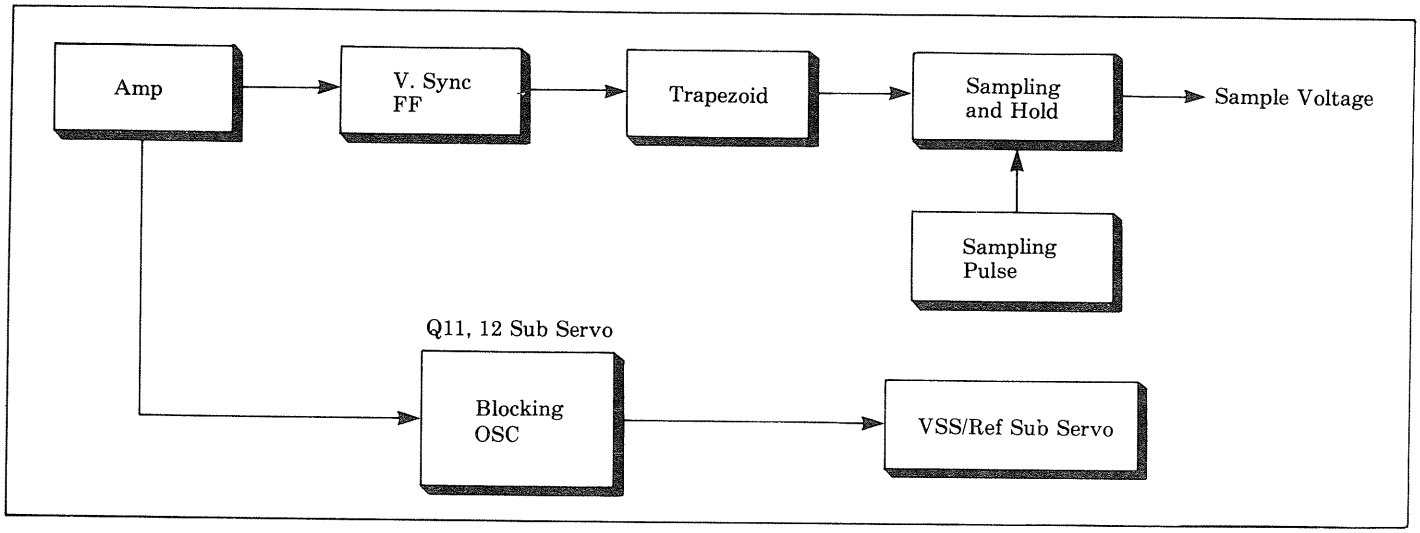



Fig. 62

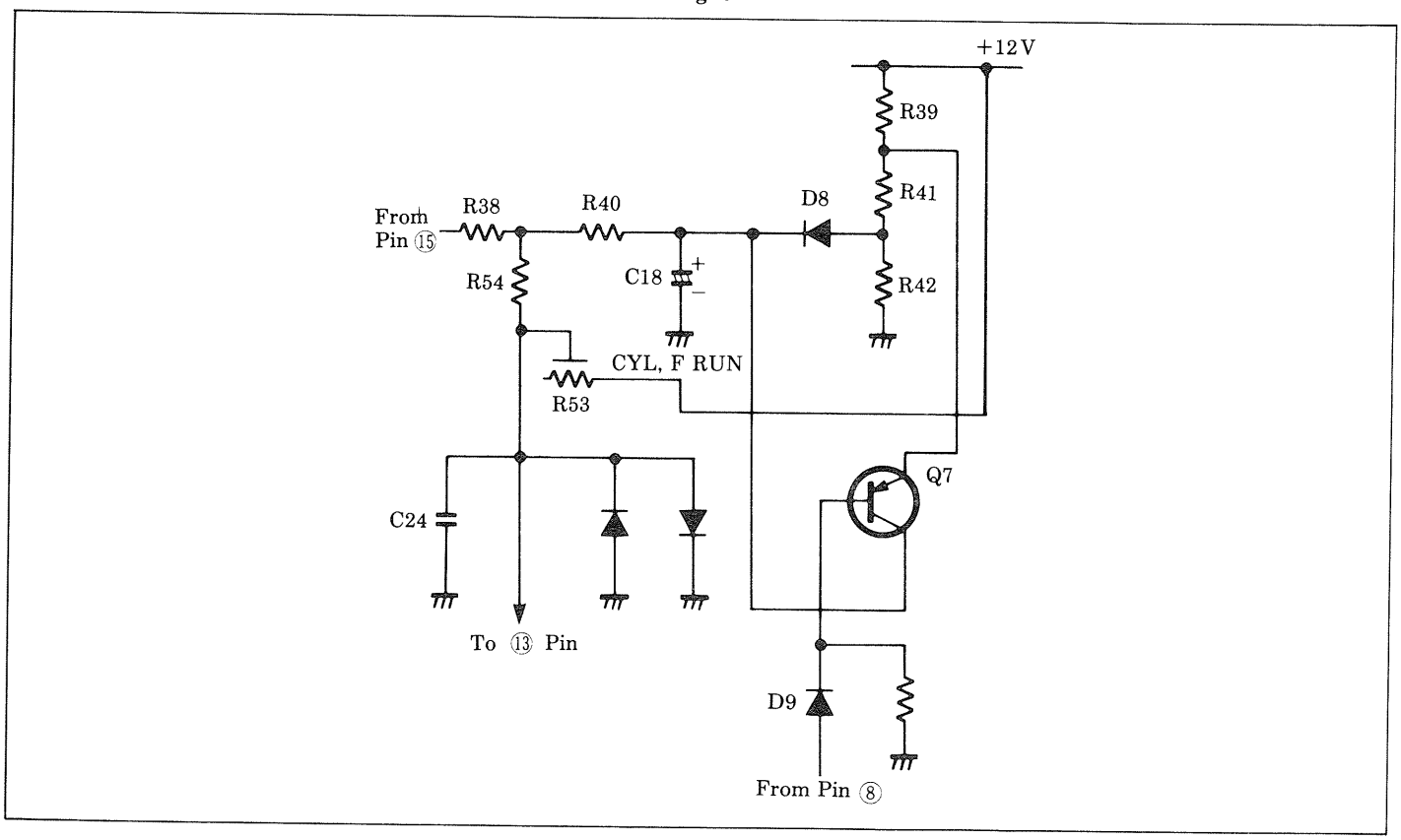



Fig. 63 Sample and Hold

Note that the output of the phase section sample and hold is fed into the speed section MMV free run voltage. This phase error output is filtered by R38, R40 and C18 for low frequency disturbance, and by R54, C25, when D6 and D7 conduction threshold is exceeded, for higher frequency elements. R39, 41, 42 form a divider to set a base level to which C18 is always charged, and D8 allows positive excursions above that limit. At turn on, when phase error is meaning less because the motor is coming up to speed, Q7 is turned on to fix the output of the phase section to its remind running value. As the error output of the speed section comes up to normal, Q7 turns off, the phase error output is passed and phase lock occurs.

SERVO BLOCK DIAGRAM

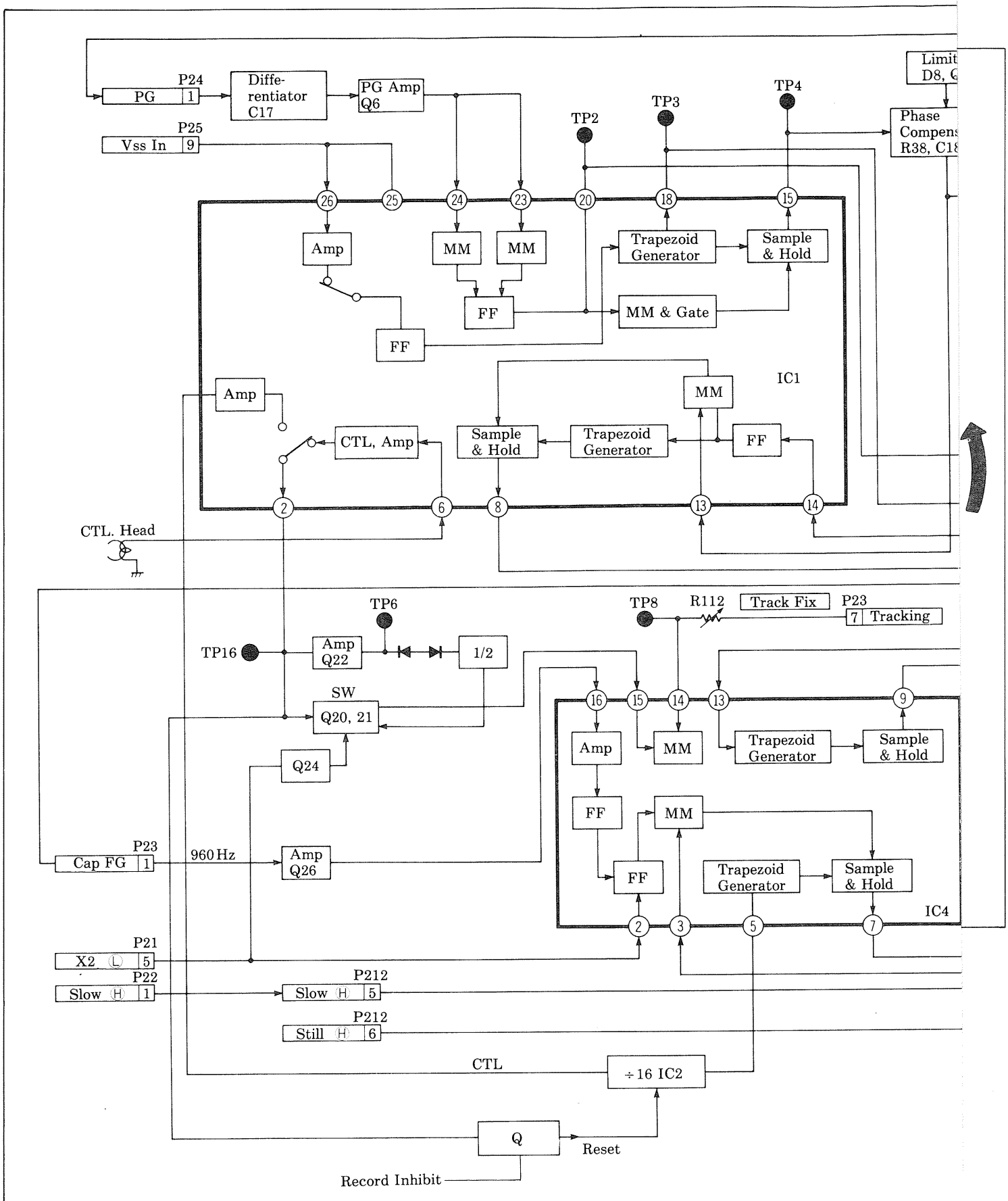



Fig. 64

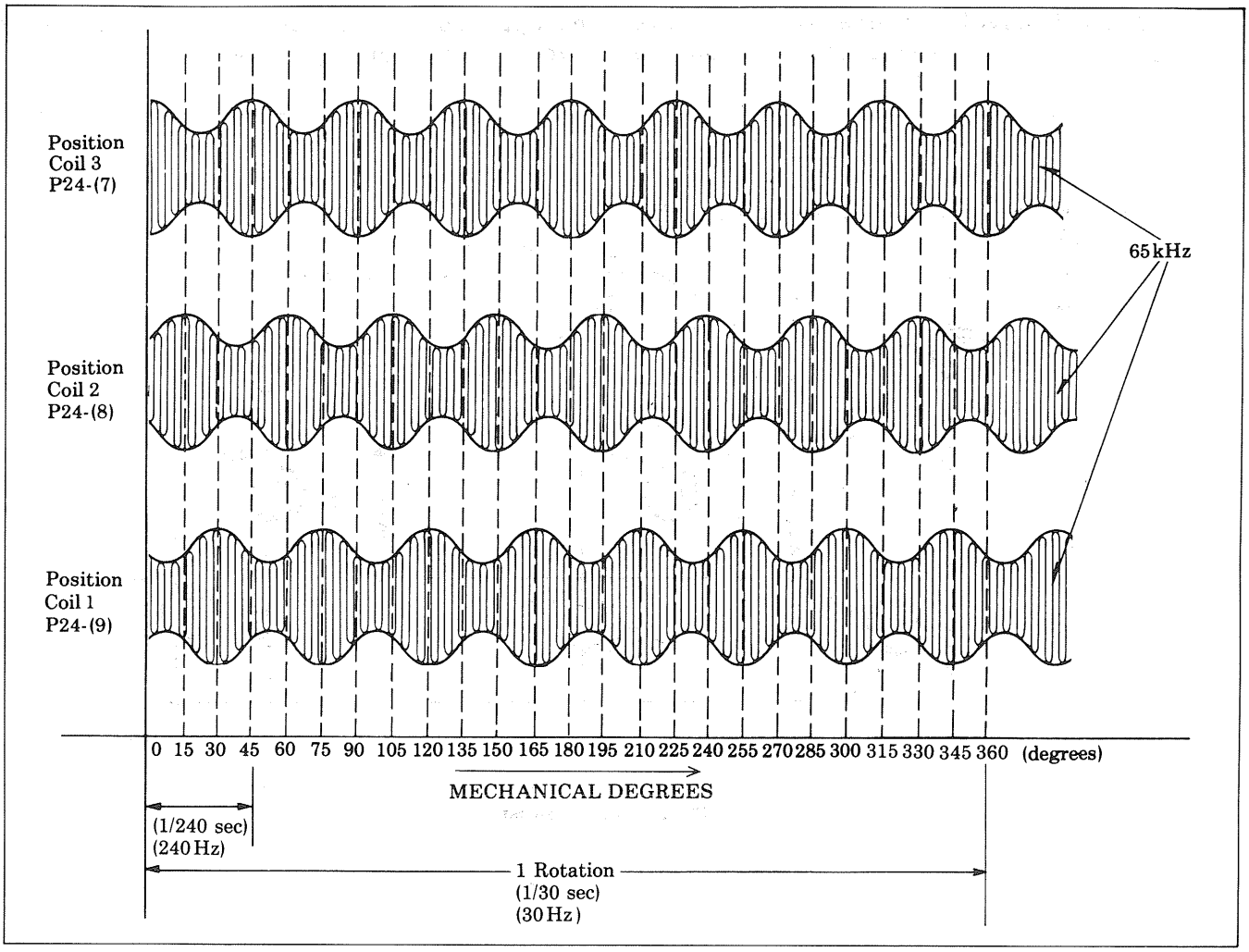

Position
Coil 3
P24-(7)
Position
Coil 2
P24-(8)
Position
Coil 1
P24-(9)
65 kHz
0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 360 (degrees)
MECHANICAL DEGREES
(1/240 sec)
(240 Hz)
1 Rotation
(1/30 sec)
(30 Hz)

Fig. 67

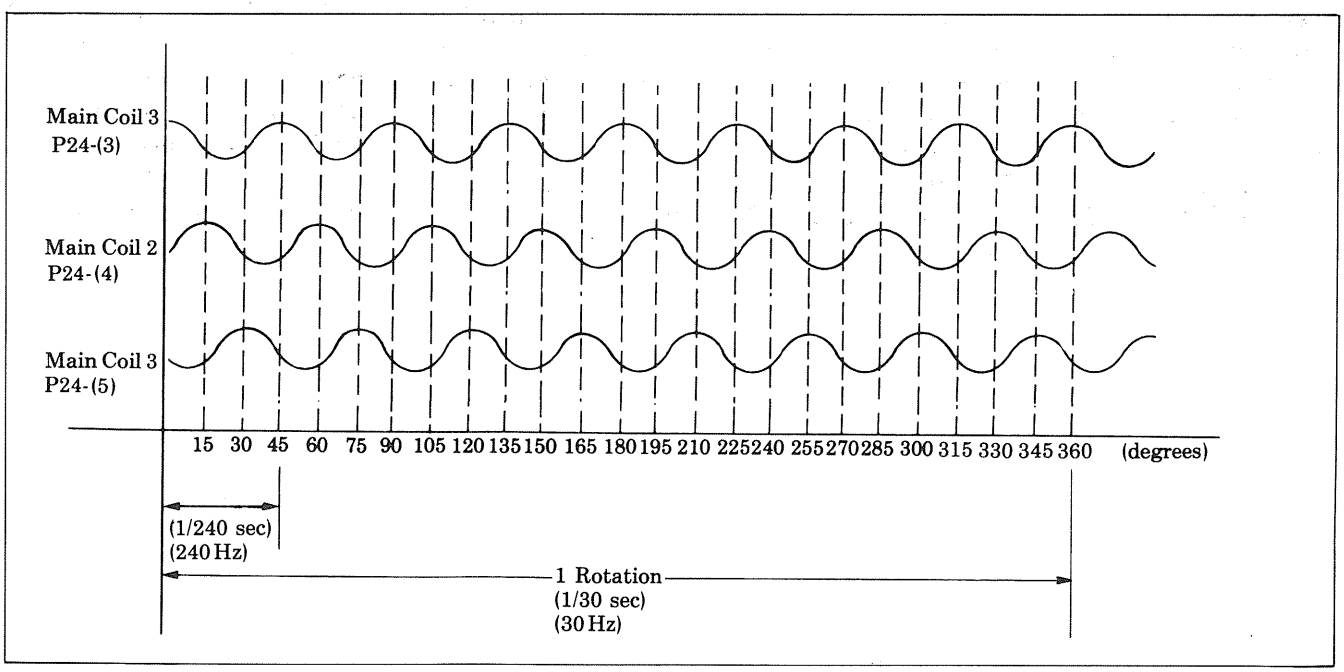

Main Coil 3
P24-(3)
Main Coil 2
P24-(4)
Main Coil 3
P24-(5)
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 360 (degrees)
(1/240 sec)
(240 Hz)
1 Rotation
(1/30 sec)
(30 Hz)

Fig. 68

The A, B and C waveforms are diode detected and applied to the bases of the switching Q11, 13, 15 which subsequently turn on the driver transistors Q12, 14, 16.

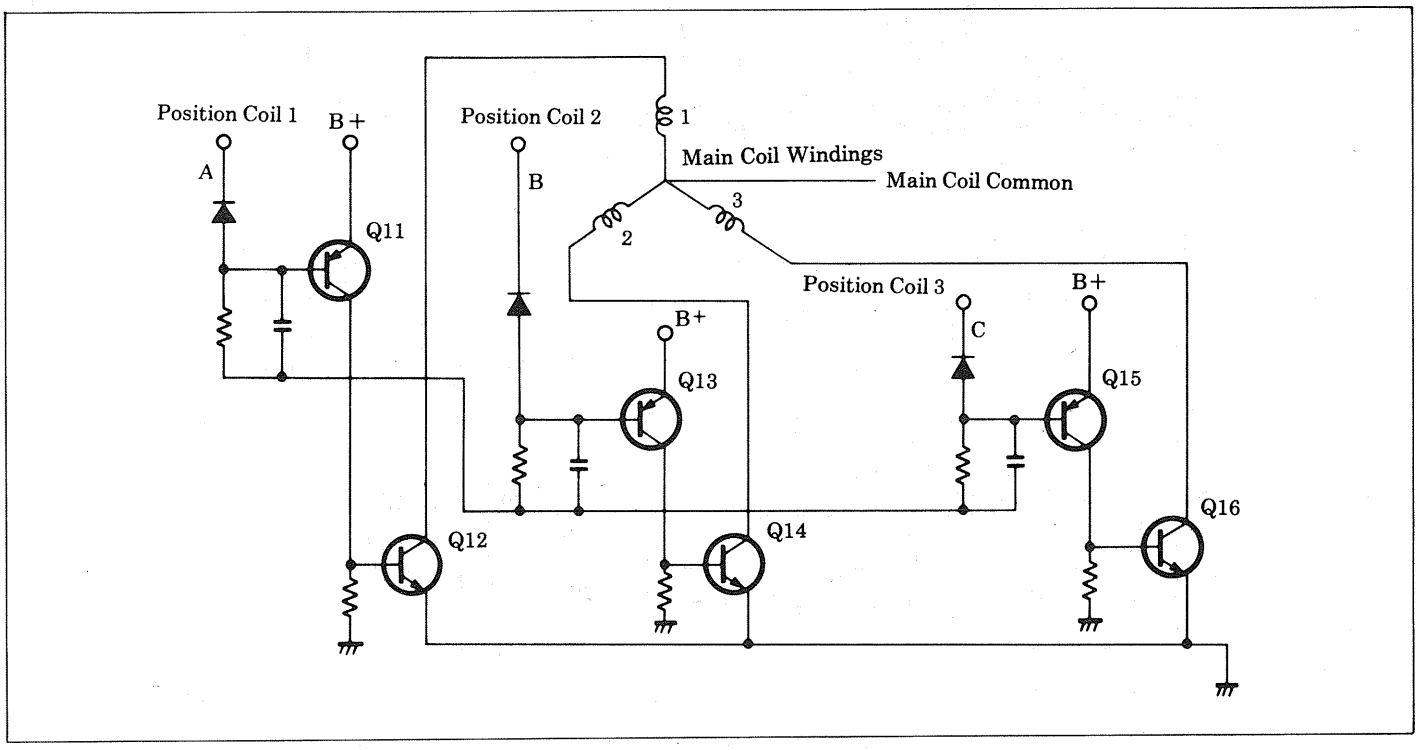



**Fig. 69 Drive Transistors**

Motor Protection

When the cylinder slows down abnoramlly, the voltage at Q10 (Emitter) goes up. Q10 turns off and Q9 will be off, so that the 12V will not be supplied to motor drive circuit. At the same time, the falling servo error signal goes to System Control 1 through P25-1 (CYL.Lock). There it is applied to the base of Q46, and normally holds Q46 on. If Q46 turns off, C16 will charge through R92. The high goes to pin (7) of IC8 through D47, P609-8, P606-9 and D36. A low level signal at pin (8) of IC8 turns on Q8, and Q7, which is connected parallel with stop SW, applying stops signal.

Cylinder Speed Control

As explained before the cylinder speed control servo utilizes the position detection and motor drive signal to form an FG signal.

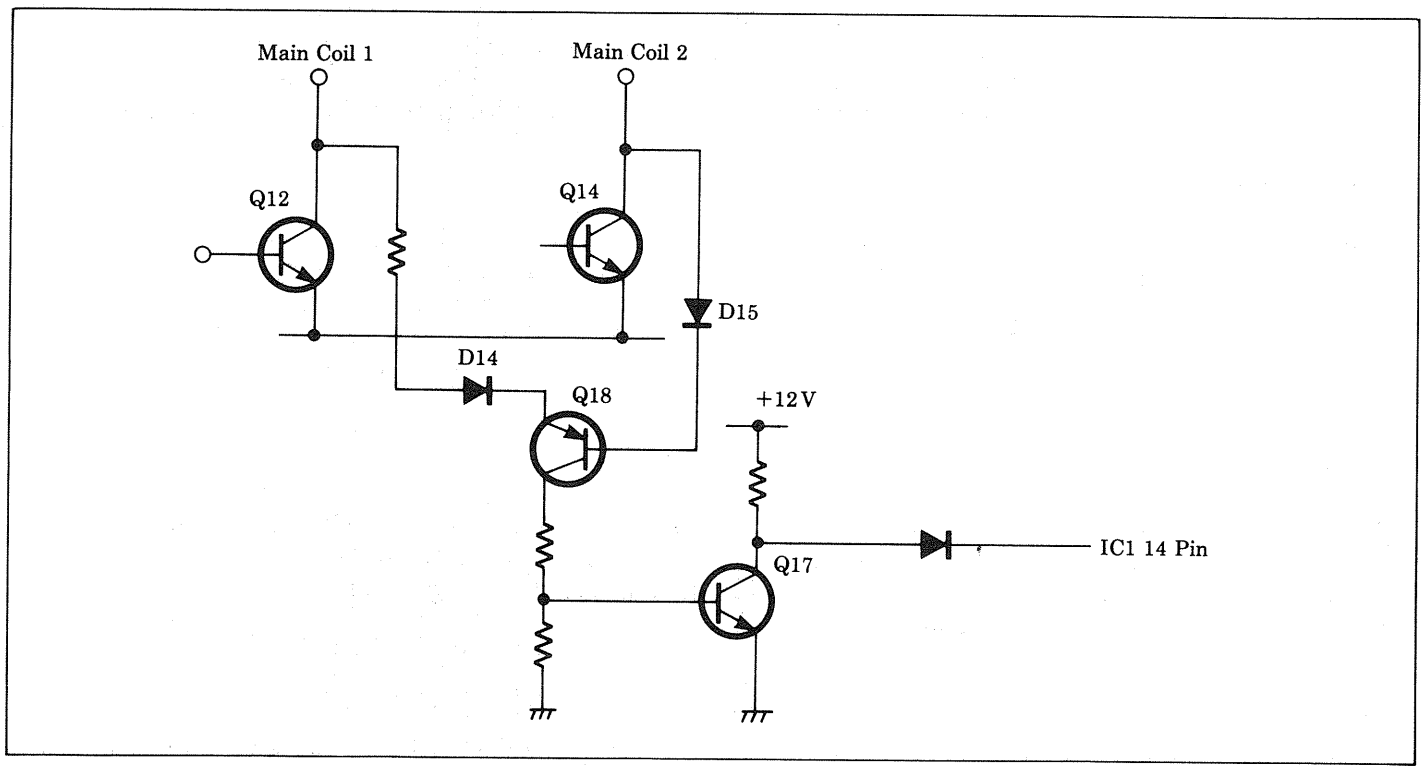



Fig. 70

The main coil drive signals, which are sine waves 120° apart in phase, are applied to Q18, emitter and base and then it is amplified and shaped by Q18 and Q17, and sent to IC1, pin (14).

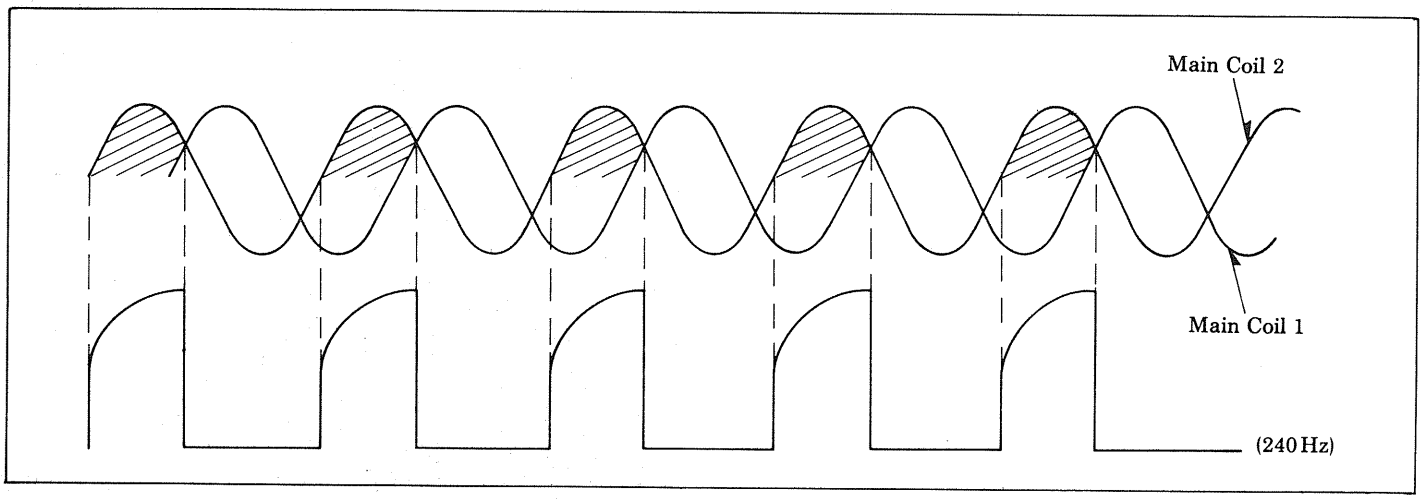



Fig. 71

Since the phase or position error feeds into the speed section as fine speed control, and the speed section output goes to the motor drive section, cylinder servo control is complete.

## Capstan Servo

### General Description

The capstan motor is an ordinary brush type permanent magnet DC motor whose drive voltage varies its speed. The capstan motor must change speeds from the normal play to slow-fast or X2 modes. In normal play the capstan drives the tape at 1.3 ips. In X2 mode this value is doubled to 2.6 ips and in slow-fast mode this value is from 0 to 1.95 ips. The speed control section therefore must handle these speeds.

### Speed Control

The capstan FG produces a 960Hz sine wave in the normal speed mode, and a 1920Hz sine wave in the X2 mode. The first process in capstan servo is to count either of these signals down to 480Hz square wave for speed discrimination. Next, the square wave is turned into trapezoid in the same fashion as described for the cylinder servo. The 480Hz trapezoid will be divided by 8 by IC2, and further divided by 2 by IC3 in record to provide 30Hz capstan PG in record.

### Motor Drive

The output of the speed discriminator, a gated monostable/trapezoid sample and hold circuit just like the cylinder, is fed to the capstan motor. Unlike the cylinder servo circuit, the capstan motor drive is DC amplifier using three transistors, Q4, 5, 6 on the Sub Servo board.

### Phase Control

A trapezoid made from the trapezoid mode from reference (V sync.) of the cylinder servo is sampled on it's rising slope by the 30Hz sampling pulse. In record this sampling pulse is the capstan FG signal counted down by 16 (called capstan PG signal) and delayed by a MMV so that it is timed to occur at the rising slope of the trapezoid. In playback, the CTL pulses from tape are used as the input to the sample pulse MMV.

Capstan Servo

Detailed Description

The 960Hz capstan FG signal is amplified by Q26, and fed to IC4-16 to be amplified and divided by 2. In the X2 mode, a second ÷2 FF is used.

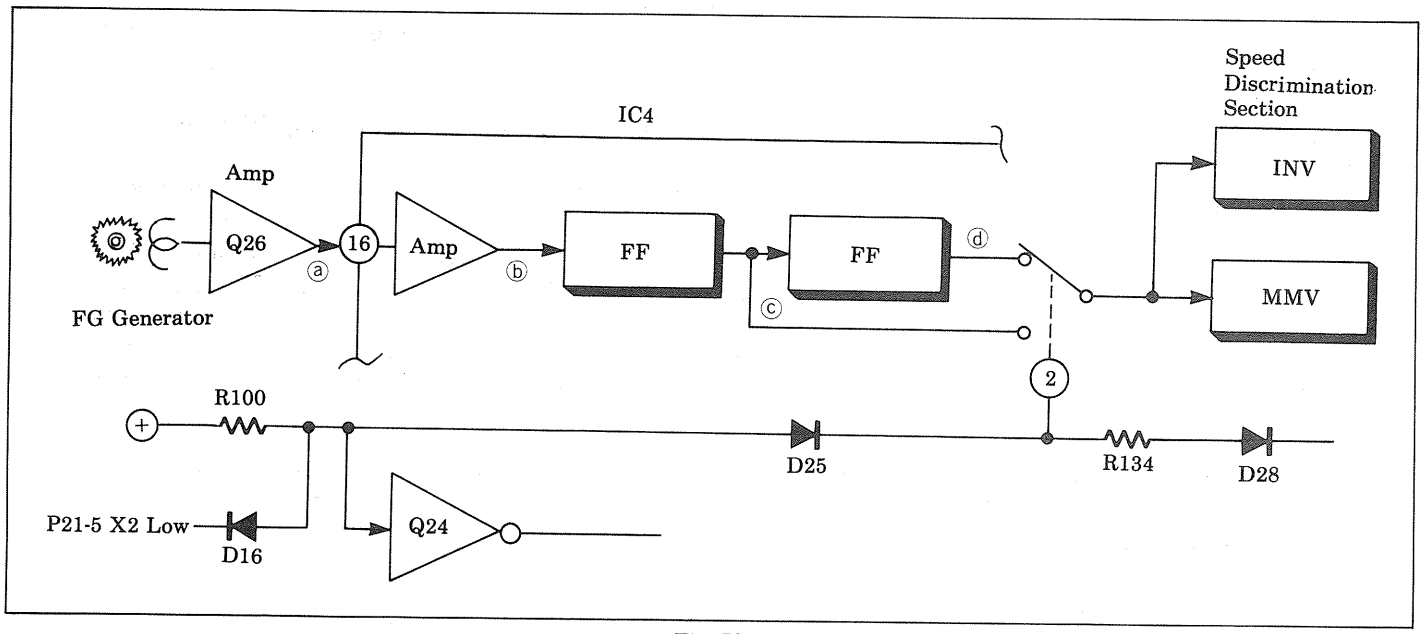



Fig. 72

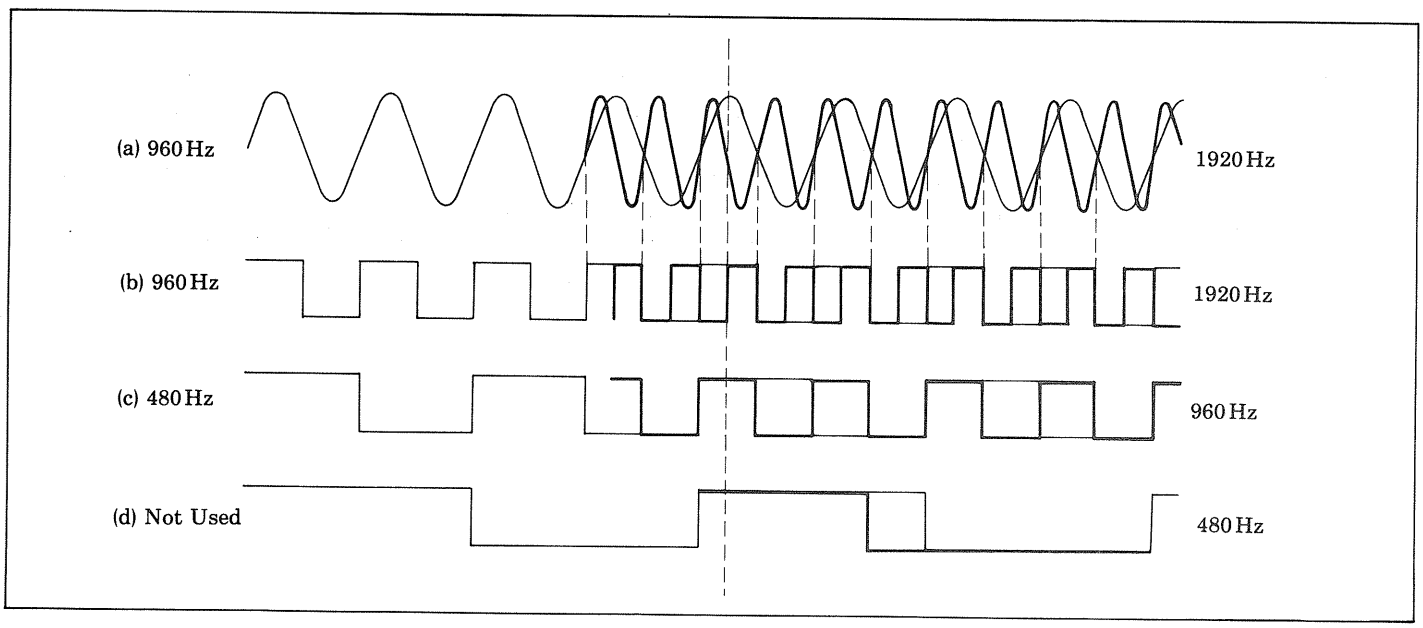



Fig. 73

The speed discriminator always operates at 480Hz for normal play or X2. The low for X2 from System Control appears at P21-5, and pulls R100 low through D16, which removes the high from IC4-2, which enables the second FF. In either the normal or X2 mode, the 480Hz at pin (5) is sent through Q27 to IC2, a divide by 16 stage, and the resultant 30Hz is sent to Q8 and then to IC1-3. In the record mode this will pass through the on chip electronic switch and go to the differential switch Q20, Q21. During normal operation, Q20 will function as an emitter follower and the 30Hz square wave will appear at IC4 pin (15) as the record capstan PG.

This will be phase locked to incoming V sync by the application of a trapezoid signal from IC1-18 to IC4-13 to be reshaped and sampled by the priviously described 30Hz Capstan PG. The output of this phase servo at IC4 pin (9) will be fillered by R124, R123, R122 and C55 before being sent through R135 to the speed control MMV along with free run D.C.
Note that C55 functions in much the same way as C18 in the cylinder section, and the divider network R115, 116, 118, 119, 120 with D23 and 24 set the upper and lower limits for phase error. Q28 will turn on to fix the phase error at a nominal value, and disregard any read error as required by D30, 31, 5: unlodaing, still and slow.
The error and free run DC go through D27, and error changes exceeding D47 or 48 conduction are filtered by C72, and at all times by C57.
IC2, the divide by 16 stage will be forced into locked counting in the play mode even through the capstan PG is not used in play. In play, the CTL head is amplified by Q3 and sent to the high gain amplifier IC1 pin (4) and through the switch to Q20 and IC4-15 just as died capstan FG. The same plug back CTL pulses will however pass through Q5 and reset or clear the counter until it runs in lock with the CTL pulses. If the machine is switched from play to record (edit style) little or no capstan phase disturbance occurs. The switch Q4 turned on in record inhibits IC2 reset in record.

Q4 and IC1-28 are driven by Q25, the record switch, which is controlled by the record hold signal P23-10. This low also grounds the front panel tracking control output through D21, and Q25 how enables the track fix 2, the record shifter.

The output of the capstan servo action IC4-7 is sent as an error signal to the sub servo board Q1, an error amplifier with its collector load on the System Control 2 board, through D5 to Q3, 4, 6, the motor drive. Q2 is turned on in slow to provide error filtering.

In Fast Forward/Rewind 1/2 speed, the voltage of the supply end of R126, capstan free run, is lowered by the divide formed by R125/R137 and D29 (now taken low), this same low shorts the phase error signal through D17.
In the slow play mode, the slow high at P22-1 turns on Q29, shunting free run and phase error to ground, as well as turning on Q30 to add R134 and C59 to the trapezoid R/C net work. Slow variable resistor (V12) DC is applied through D26 and R127. This path is normally blocked by D2, since slow high is normally low.

SLOW/STILL MODE

VHS Format Simplified

In the original design of the VHS format, the capstan speed was chosen to work in conjunction with the head drum diameter and angle to produce a unique set of conditions. (See Fig.74.) The head width is 58μm and the linear tape speed (33.35 mm/sec) will advance the tape just enough so that the next pass of the video heads will make a contiguous track (no guard band). Further, the heads hone a ±6° azimuth shift from perpendicular (relative to the axis of the cylinder), so that the "A" head will only play back an "A" head track, and head "B" only a "B" track.

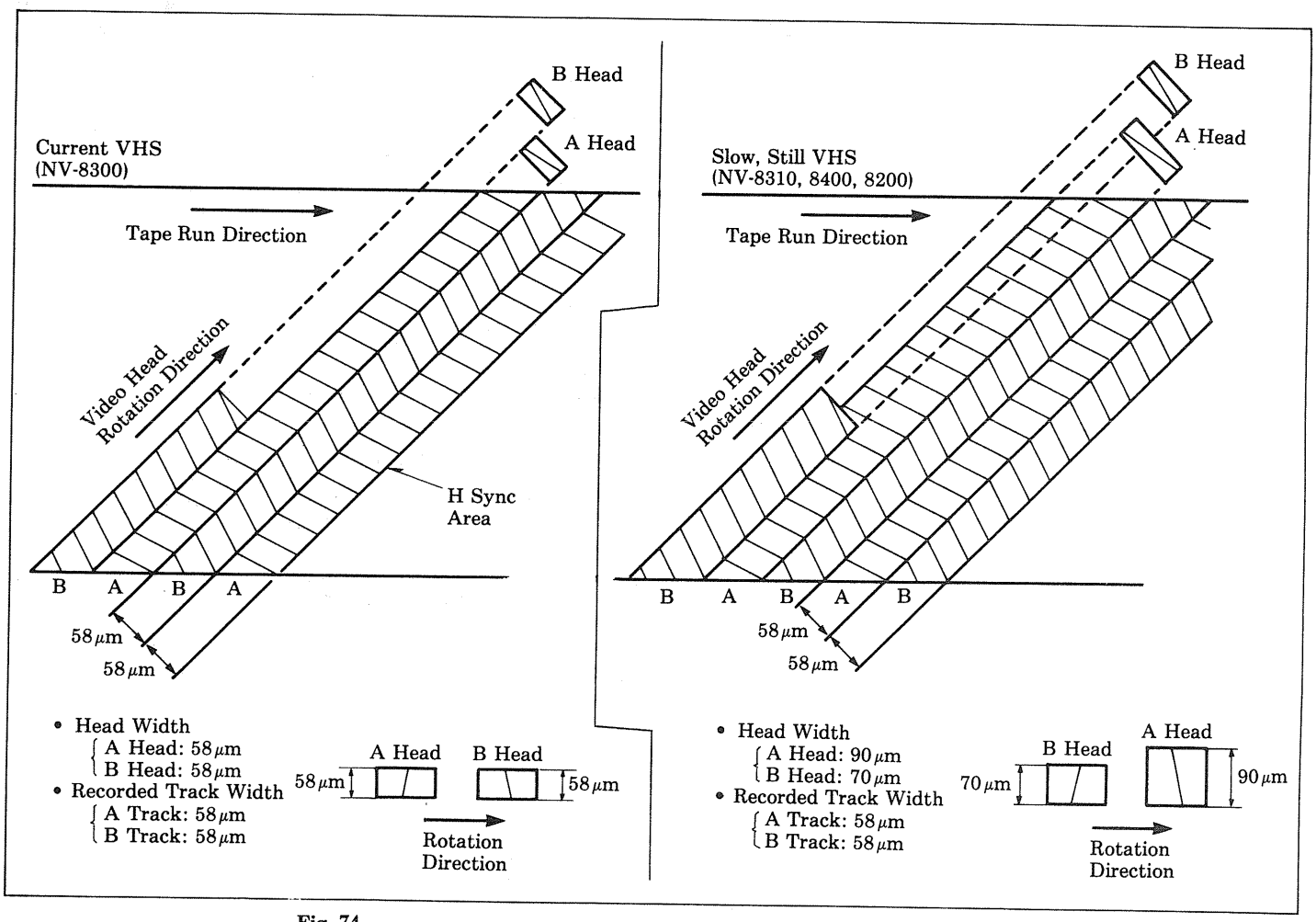



Fig. 74

Fig. 75

Due to the head cylinder size and speed, the horizontal sync area in the recorded video in each track will align with the sync area in the adjacent tracks. In order to get perfect still and perfect X2 playback, the head width has been increased to 70μm and 90μm. (See Fig.75.) Since the heads have a common base line, the tape speed will determine the track width in record (the tape will only advance a certain distance) and the remainder of the perilously recorded over wide track will be "recorded over" by the next head, leaving the standard 58μm wide pattern.

In normal playback, the heads are centered over their respective tracks. In the still mode, the tape will be moved until the heads line up as shown in Fig. 76-3. Notice the progression, assuming the tape stopped as depiched in Fig.76-1, when one noise bars would be seen, through the alignment shown in Fig.76-2 where one noise bar would be seen, to the final alignment, where no noise bar would be observed. Since the heads are spinning and fixed on the transport, this alignment is accomplished by jogging the tape with the capstan.

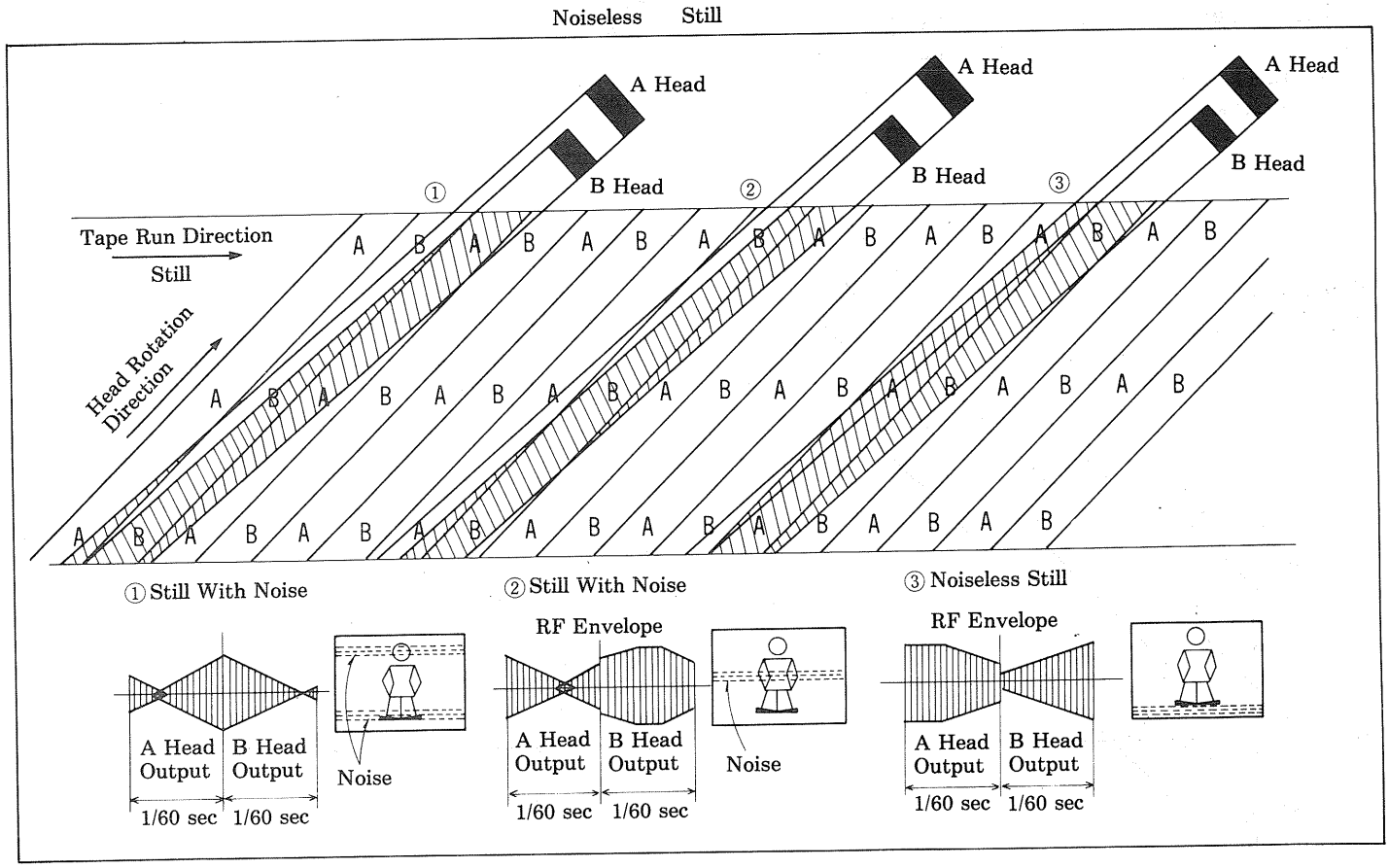



Fig. 76

These wider heads also allow the playback of a normal tape at twice normal speed (X2) without a noise bar in the picture. If the video heads randamly scanned the tape which was moved by the capstan at a faster than normal rate, the condition depicted in Fig .77-1 might exist, and a noise bar would be present.
However, if the capstan servo is utilized, and is led only every other control track (CTL) pulse (by dividing the CTL head output by 2), as well as dividing the capstan frequency generator (FG) by 2, the speed and position servo loops function to hold the heads any tape in the relation ship shown in Fig.77-2.

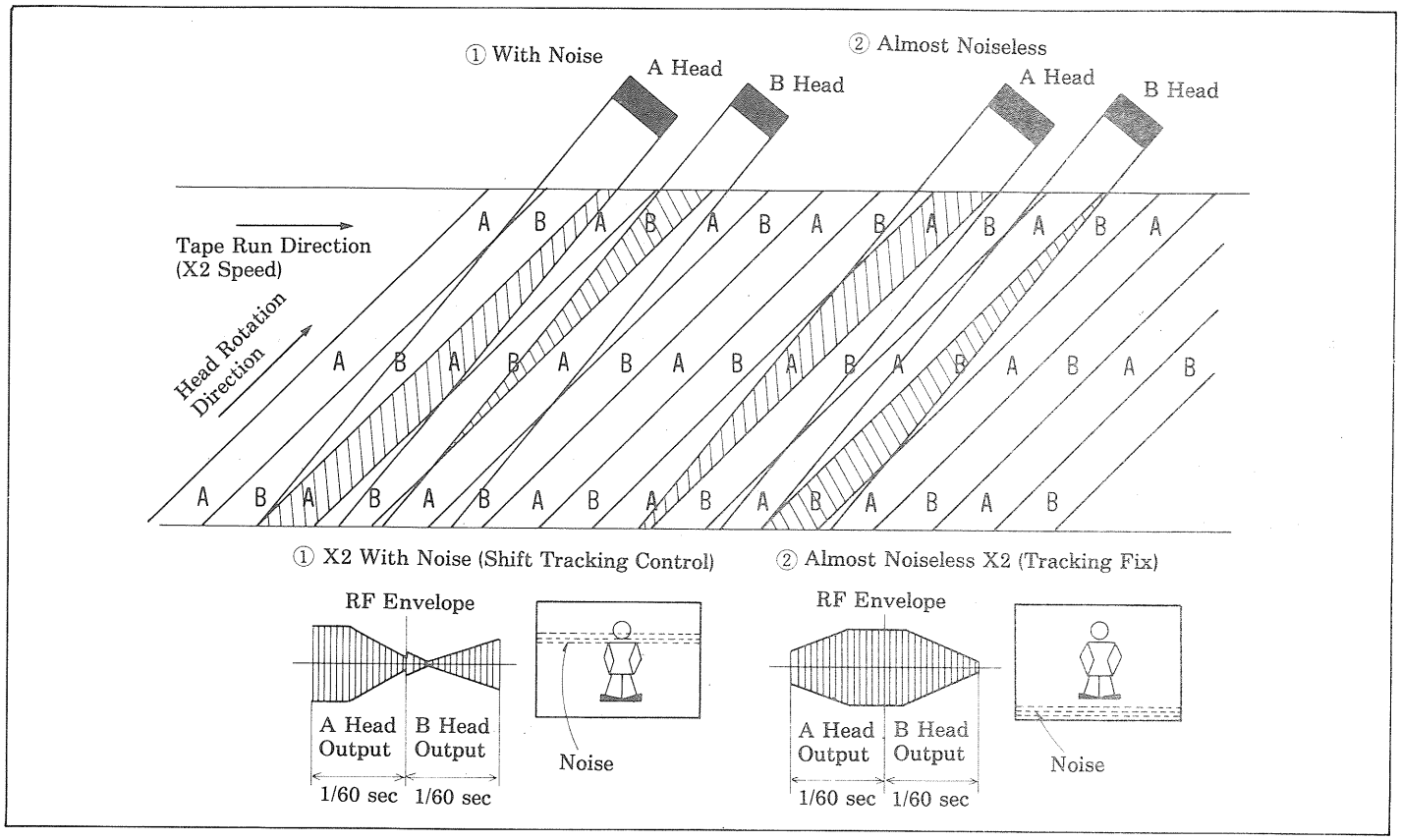



Fig. 77 X2 Playback

During normal playback, the servo error voltage is applied from pin (7) of IC4 on the servo (S1) board to pin (11) of connector P212 on the sub servo (S2) board. This drives the capstan motor amplifier through Q1; the Q1 collector supply and load are on the System Control II board.

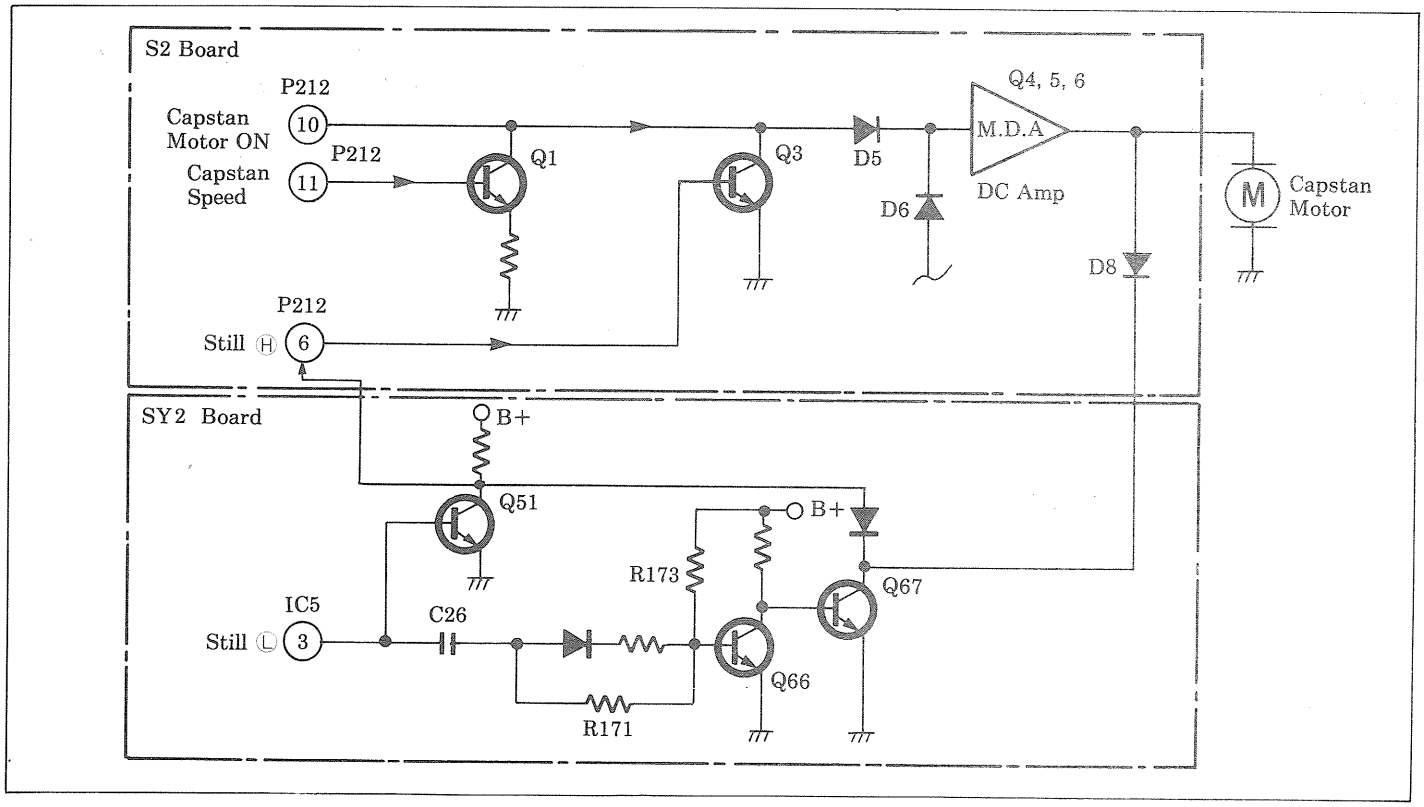



Fig. 78

When the still button is pressed, the STILL High Signal from Q51, SY2 board is applied on P212 pin (6) which turns on Q3, grounding the capstan motor drive signal. D5 isolates this ground from other inputs to the MDA, Q4, 5, 6.

When the STILL key is pressed, pin (3) of IC5 on the SY2 board goes low. Therefore, in all modes except STILL, C26 is kept charged by the High from pin (3) of IC5. When pin (3) goes low, C26 starts discharging about 1 sec, Q66 turns off and Q67 turns on.
This means that at the start of the still mode, a closed loop can be obtained for 1 second to short the capstan motor. Since, before pressing the STILL key, the

capstan motor was rotating, as it coasts to a stop it will act as a generator. The reverse electro-motive force created will be short circuited when both + and - terminals of capstan motor are grounded, and this dynamic brake effect will provide capstan motor instant stop. After about 1 second, Q66 turns back on, Q67 turns off, and D8 is reverse biased. (See Fig.79.)

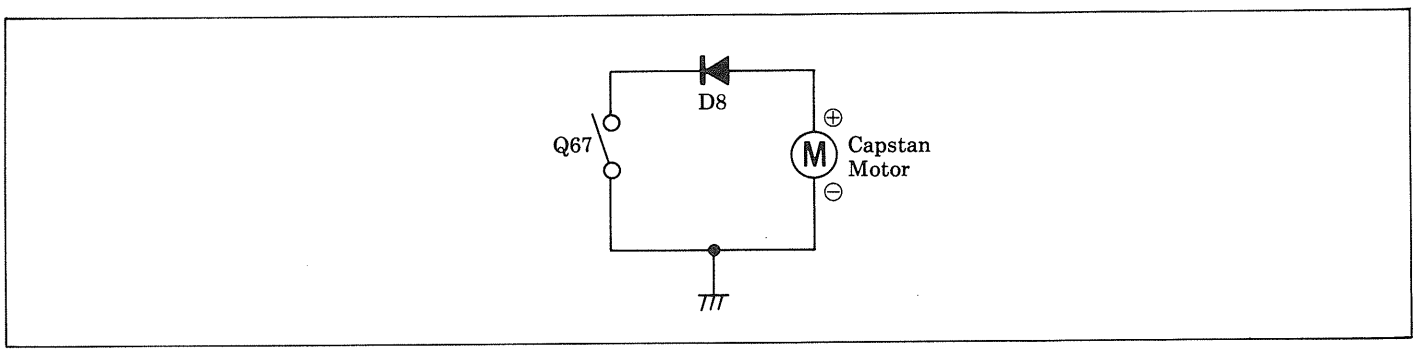



Fig. 79

The STILL Hi signal remains at the base of Q3, keeping it on. Therefore, the capstan error drive does not reach the DC amps Q4, 5 and 6.
Instead of capstan error signal, still pulses are applied to the DC amps Q4, 5 and 6 through D6 to make the noise band which appears on the TV monitor advance until it coincides with the vertical blanking area. This means that to force the noise band to advance to the vertical blanking area, the capstan motor must driven by pulses, and it inform will jog the tape.
These pulses must come at the proper rate, and when the noise band has advanced into the vertical blanking area, the pulses must be turned off.

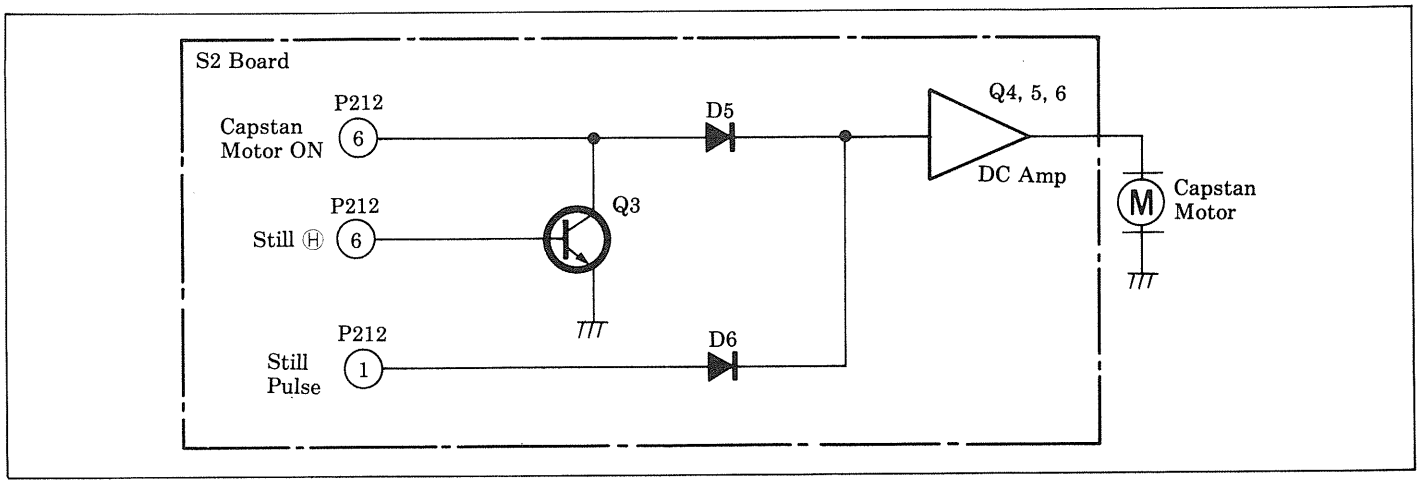



Fig. 80

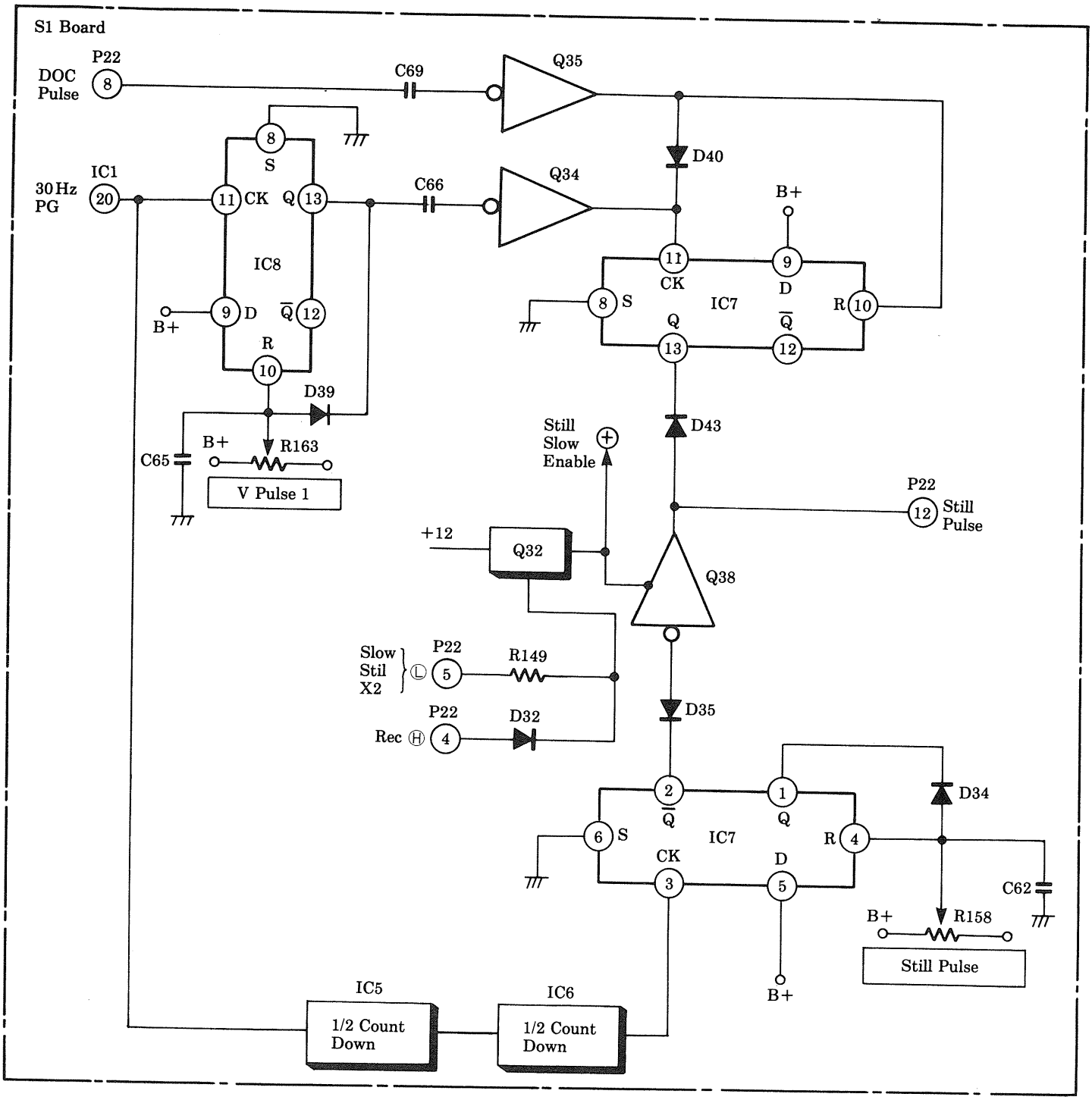



Fig. 81

In order to get the proper repetition rate, the 30Hz head switching pulse is divided down to 7.5Hz by two ÷ 2 stages, IC 5 and 6. This is the proper rate for the jogging pulses, but far too long in duration, so 1/2 of IC7 is used as a one-shot or monostable multivibrator (MMV), with the output pulse period set by R158. To make the D type Flip Flop (FF) of IC7 perform as a one-shot, the Q output is fed to an R/C network and into the reset (R) input, while the Data (D) input is held high. The rot Q ($\bar{Q}$) or inverted output is used. (See Fig. 81.) The +12 supply for still/slow/X2 is formed on by Q32, which gets a low from still/slow/X2 low, P22-5. This low is over ridden in record by a high through D32 from Record H, P22-4. The slow pulse inverter Q38 receives +12 from Q32, and is driven through D35 to make positive pulses out P22-12, still pulse.

These pulses will be sent to D6 and the capstan MDA (Q4, 5, 4) an the sub servo board.(See Fig. 80). When the motor brake circuit is on, D4 (S2 board) prevents a drive signal from turning on the MDA when its output is short circuit (brake on), and D3 inhibits pulses when not in the still mode, since P212-6 is High in still only.

At the same time, in order to get stable pictures in the still, variable speed, or X2 mode an artificial vertical (V) sync pulse is made from the head switching pulse. In the VHS format, head switching occurs 3.5 horizontal lines (H) prior to the start of the vertical internal, or 6.5H prior to vertical sync. This fixed relationship allows the delay of both edges of the head switch pulse (30 Hz) into 60Hz delayed artificial V sync.

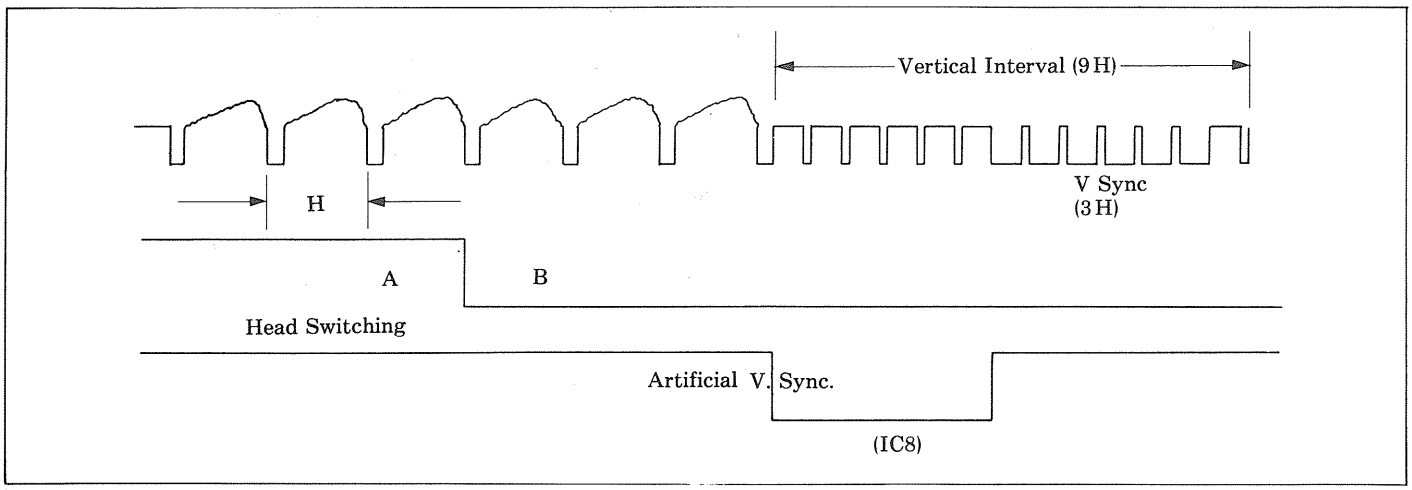



Fig. 82

By the case of two one shots (IC8) and an inverter Q31, two delayed pulses are made representing V sync, and they are diode gated by D37 and 38. As in IC7 the D type FF used as a one shot. The mixed pulses are shaped by C61/R151 and Q33, and sent to the luminance process board for injection into the output signal. Since these pulses become the "new" vertical sync, they will define the time of vertical reference or blanking, and so provide the first known of perfect still: vertical blanking.
In addition to becoming V sync, the pulse from IC8 pin (13) is inverted by Q34 and used to clock IC7 pin (11), another Q type FF, which is used to gate the coincidence of V sync and picture noise bar. The D input of IC7 pin (9) is held high, and the V sync pulse at the clock puts the Q output high. This high will allow the slow pulses previously discussed to pass, since D43 was shunting them to the low at the IC7 FF Q out, pin (13).
The noise bar in the picture appears as a large concentration of dropouts of the FM off type signal to which the dropout compensator (D.O.C.) readily responds. Too readily, in fact, so the D.O.C. gain or threshold is reduced by turning on Q37, connecting the bias from C70 and R174. The bias is driven more positive at points of numerous dropouts, since the drop out pulse (D.O.C. Out) turns on Q34. The drop out pulse also is inverted by Q35, and integrated by C67, 68 and R168. The pulse from Q35 will reset the FF IC7 which gate the slow pulses only when the dropout coincides with vertical sync since D40 and R167 shunt any DOC output away from the reset input IC7 pin (10), unless the V sync pulse from Q34 is present at pin (11). Since the reset has precedence over clock, the Q output goes low, and D43 inhibits any further slow pulses from going to the capstan M.D.A.

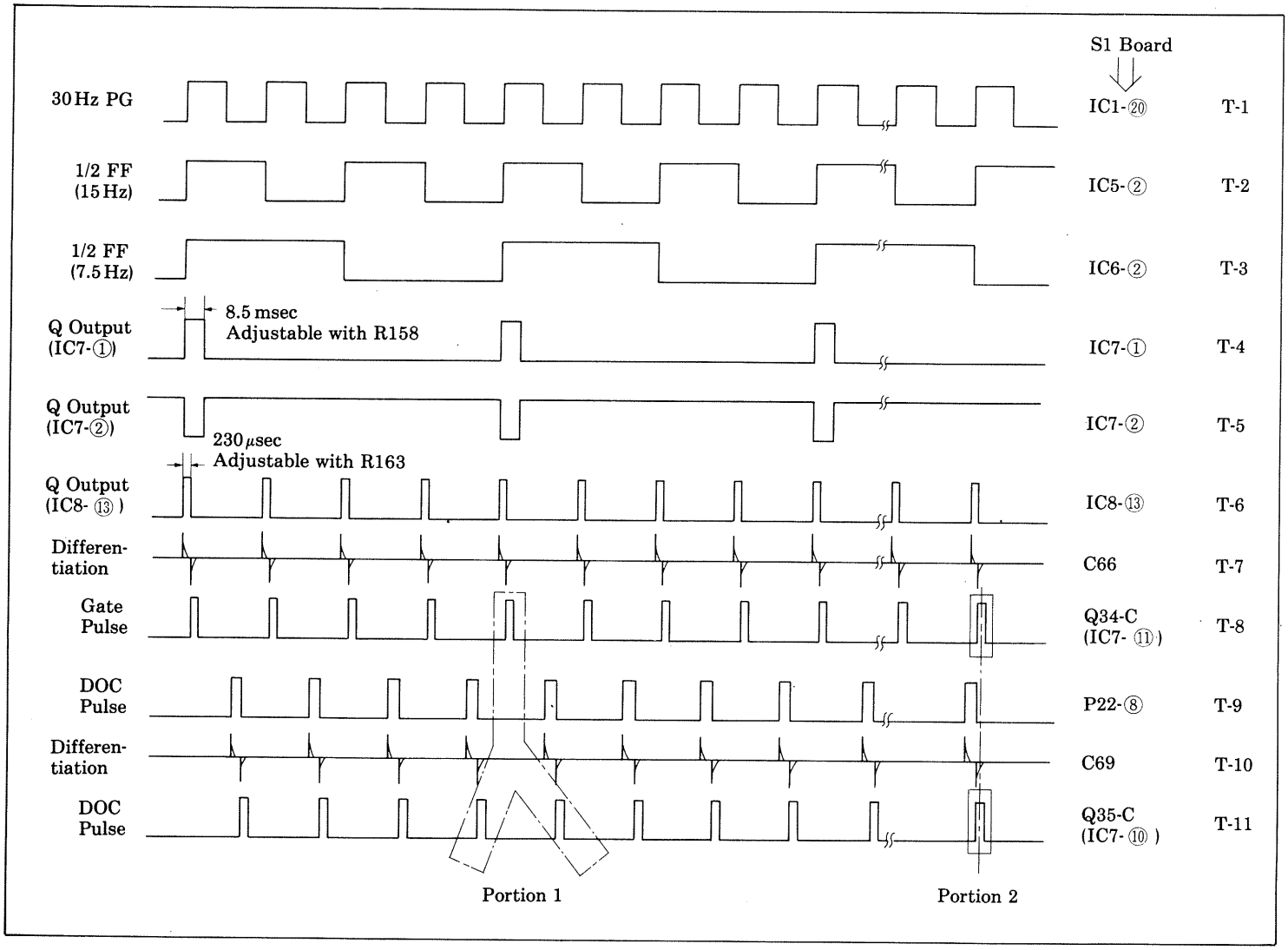

S1 Board
30 Hz PG
IC1-⑳
T-1
1/2 FF (15 Hz)
IC5-②
T-2
1/2 FF (7.5 Hz)
IC6-②
T-3
8.5 msec
Adjustable with R158
Q Output (IC7-①)
IC7-①
T-4
Q Output (IC7-②)
IC7-②
T-5
230 μsec
Adjustable with R163
Q Output (IC8-⑬)
IC8-⑬
T-6
Differen-tiation
C66
T-7
Gate Pulse
Q34-C (IC7-⑪)
T-8
DOC Pulse
P22-⑧
T-9
Differen-tiation
C69
T-10
DOC Pulse
Q35-C (IC7-⑩)
T-11
Portion 1
Portion 2

Fig. 83

Detailed Description

For the luminance Process Circuit

(Video Recording)

Low-Pass Filter

The video signal from pin (4) of connector P31 enters the Low-Pass Filter, FL1. This filter eliminates any unwanted energy above 4MHz... thus allowing only bonafide video signals to pass.

The signal enters the filter on pin (1) and leaves via pin (3).

AGC

The signal now enters the AGC stage in IC1 through pin (1).

The AGC here is a keyed AGC configuration. The signal entering pin(1) passes through the AGC block. The signal output, of from pin(22), re-enters on pin (5) and is sent to the sync separator and AGC Detector inside of IC.1. By using a keyed AGC circuit to control the video level, a steady video level can be obtained at the output of AGC circuit regardless of incoming video signal level.

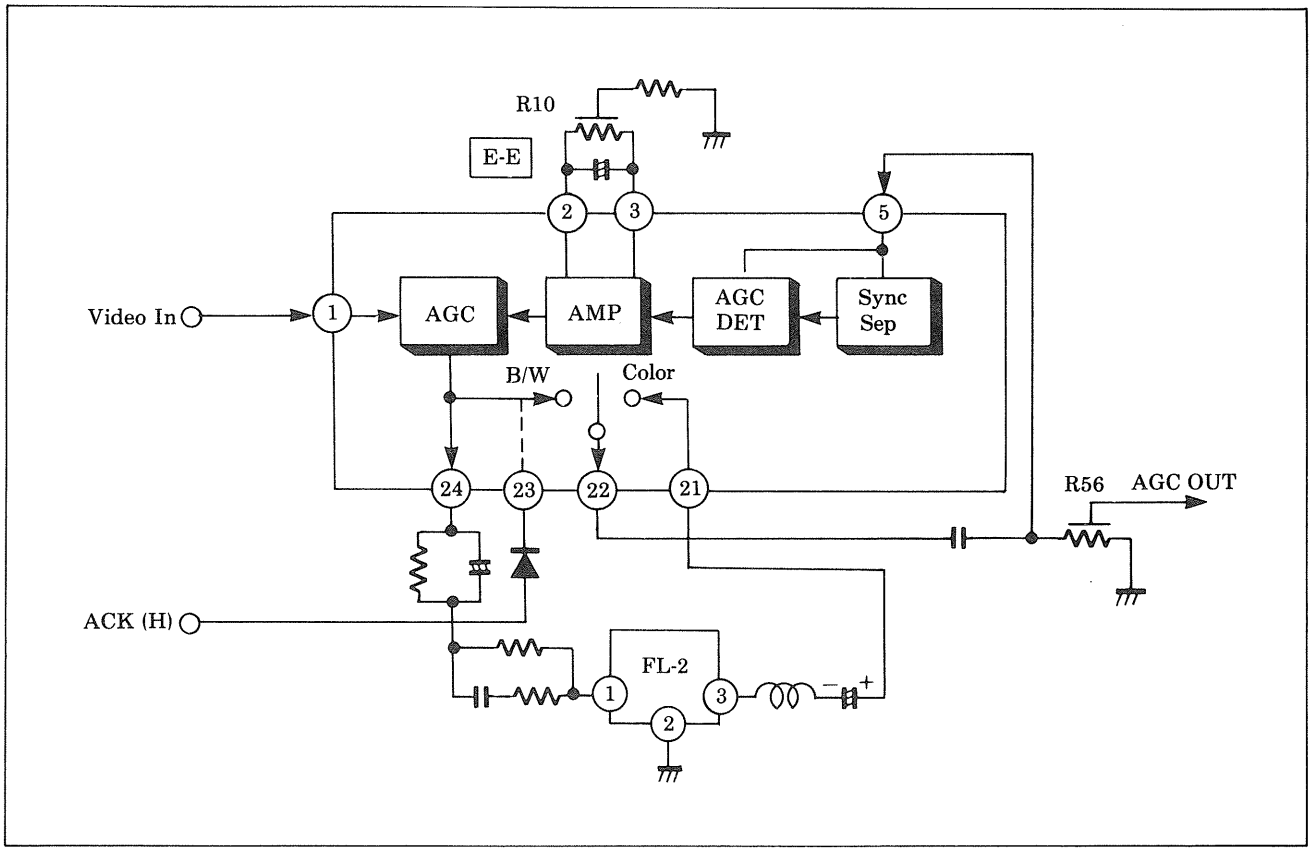



Fig. 86

FL2 is the Low Pass filter which blocks any color information (3.58MHz) from 4.5MHz being fed back, since overall signal amplitude cannot be judged by color content. If the overall sync amplitude drops, the AGC Detector increases the gain of the AGC amplifier.

The converse is also true. The AGC signal appears at pin (22), and enters pin(19) through R56 which is a video amplitude control.

R56 effectively adjusts frequency deviation for 1MHz (3.4 ∿ 4.4MHz).

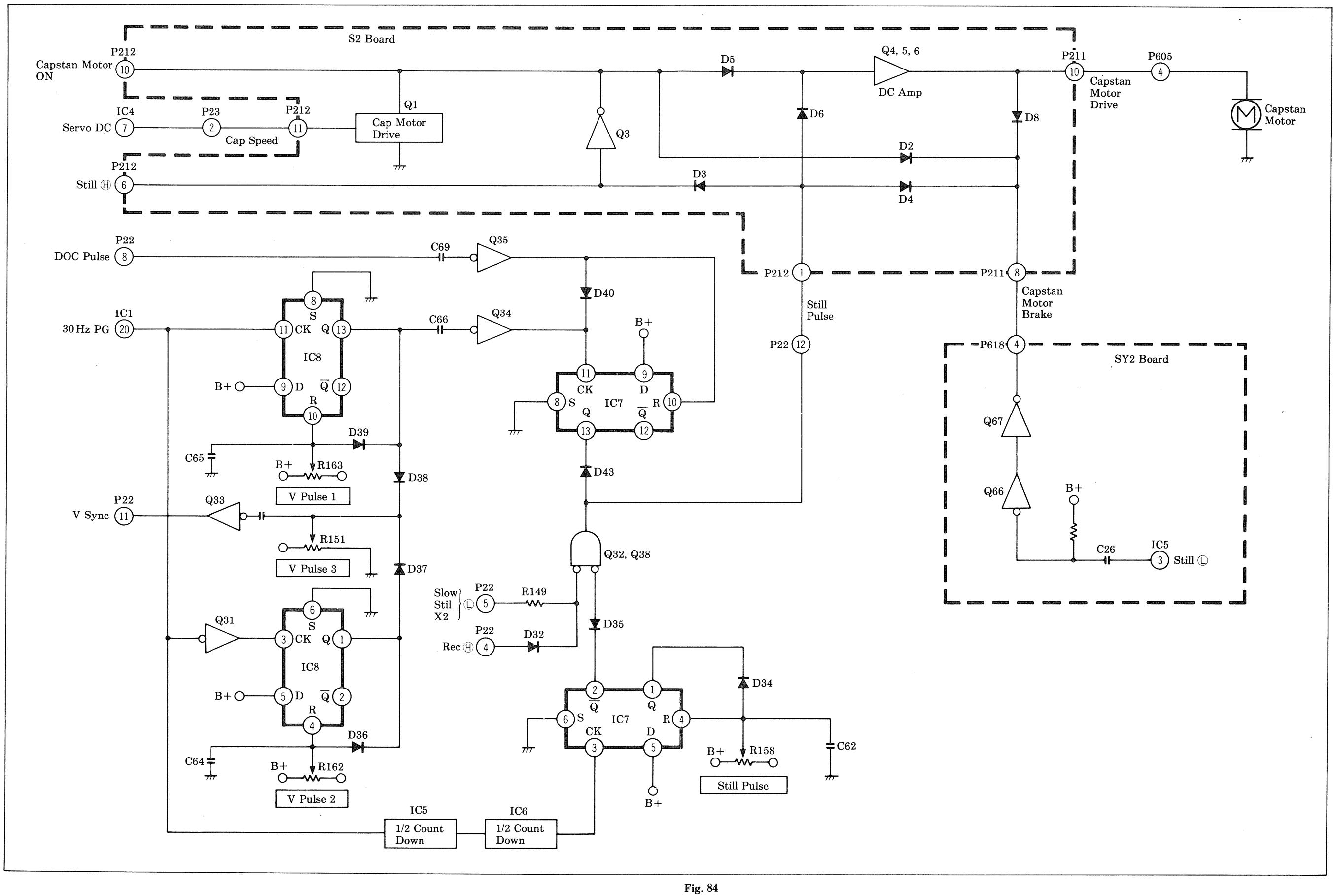

S2 Board
P212
Capstan Motor ON
10
D5
Q4, 5, 6
DC Amp
P211
10
P605
4
Capstan Motor Drive
Capstan Motor
IC4
Servo DC
7
P23
2
P212
11
Cap Speed
Q1
Cap Motor Drive
Q3
D6
D8
D2
P212
Still Ⓗ
6
D3
D4
P22
DOC Pulse
8
C69
Q35
P212
1
P211
8
Capstan Motor Brake
D40
Still Pulse
IC1
30 Hz PG
20
C66
Q34
B+
P22
12
P618
4
SY2 Board
IC8
S
CK
Q
R
D
IC7
Q67
B+
D39
C65
B+
R163
D38
V Pulse 1
Q66
P22
V Sync
11
Q33
R151
V Pulse 3
D37
C26
IC5
3
Still Ⓛ
Q32, Q38
Slow Stil X2 Ⓛ
P22
5
R149
D35
P22
Rec Ⓗ
4
D32
Q31
D34
C62
B+
R158
Still Pulse
C64
B+
R162
V Pulse 2
D36
B+
IC5
1/2 Count Down
IC6
1/2 Count Down

Fig. 84

## LUMINANCE RECORDING PROCESS

The simplified block diagram for the Luminance Record Process is shown below: Fig. 85.

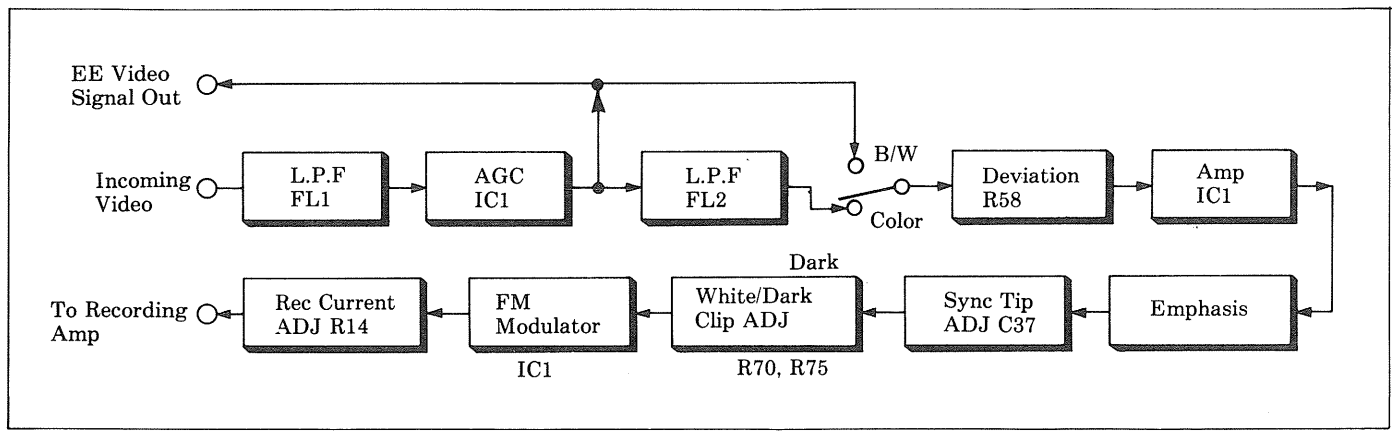



**Fig. 85**

The block diagram shows the signal flow path in the record mode for the Luminance portion.

### LOW PASS FILTER

The video signal is first passed through a filter to remove any undesirable information above 4MHz.

### AGC

The low-pass filtered signal is then sent to an AGC stage inside of IC1. The AGC action of this IC maintains an overall constant level of the video signal. This is accomplished by measuring any overall change in sync level. If the level decreases, the gain of the AGC amplifier increases. The converse is also true.

### B/W COLOR SWITCHING

The Luminance and Chrominance portions of the video signal are treated in different ways.
Therefore, no color information should be processed by the Luminance board.
If a color signal is being recorded, a color (3.58MHz) trap is used by the Luminance board to remove all color information. If a B/W signal is being recorded, it is not necessary to use the trap, so it is bypassed. It is desirable in the case of a B/W signal to bypass the color trap in order not to inadvertantly remove any B/W information near 3.58MHz. This will yield sharper B/W pictures.
The switching is controlled by a color detector on the color board, the ACK circuit.

### ACK

Although this will be described in the chrominance section, it should be mentioned here that several boards of the unit receive a special +9V signal (ACK) when a color signal is being recorded.

### EMPHASIS

Emphasis action boosts the level of the high frequency portions of the signal. Upon playback, these signals will be de-emphasized, which will restore the signal to its original level, and will also reduce noise.

### DEVIATION

The emphasized signal must now be controlled in amplitude. It is the amplitude o the signal that determines how far the FM carrier will swing. To make sure that the FM modulators of all units function the same, the amplitude of the emphasized signal must be made the same. The amplitude is controlled by R56, the DEVIATION control.

### SYNC TIP

Since the peak to peak level of the signal must be adjusted with the DEVIATION control, the average DC level of the signal must also be controlled. The DC leve of the signal determines where the FM carrier will rest, in terms of frequency, and the amplitude will determine how far from this resting point the carrier will swing.
This DC level adjustment is performed in such a way that the sync portion of the video signal is actually what is assigned a specific DC level, or "clamped".
The sync portion, being the lowest-level point of a video signal will set the low end swing of the carrier. The brightest (or peak white) portion of the signal wi set the high-end swing of the carrier.

### CLIP

The final process is that of white and dark clipping. After emphasis, the high-frequency portions of a video signal will be boosted.
Signals with very rapidly changing brightness levels (for instance stairsteps, or bars) have high frequency content at the point of a change.
It is possible that the emphasizing process will boost these portions a bit too much. It is the purpose of the white and dark clip circuits to cut off these boosted portions at an adjustable level.
This way, the FM carrier can be prevented from "over deviation" which may produce poor pictures.

### FM MODULATION

The processed signal is then used to control the FM modulator, whose output signa from 3.4MHz to 4.4MHz is recorded on the tape.

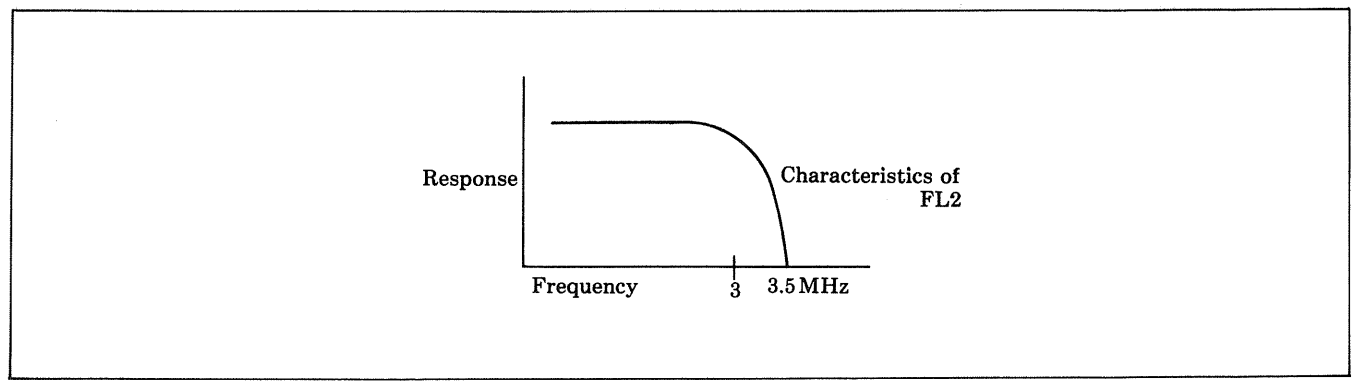



Fig. 87

Regular Emphasis, Dark Clip and White Clip

The AGC'd signal enters pin (16) of IC1. Between pins (15) and (12), white clip, dark clip and regular emphasis actions are performed.

The regular emphasis action is done by feeding back the output from pin (12) of IC1 to pin (15).

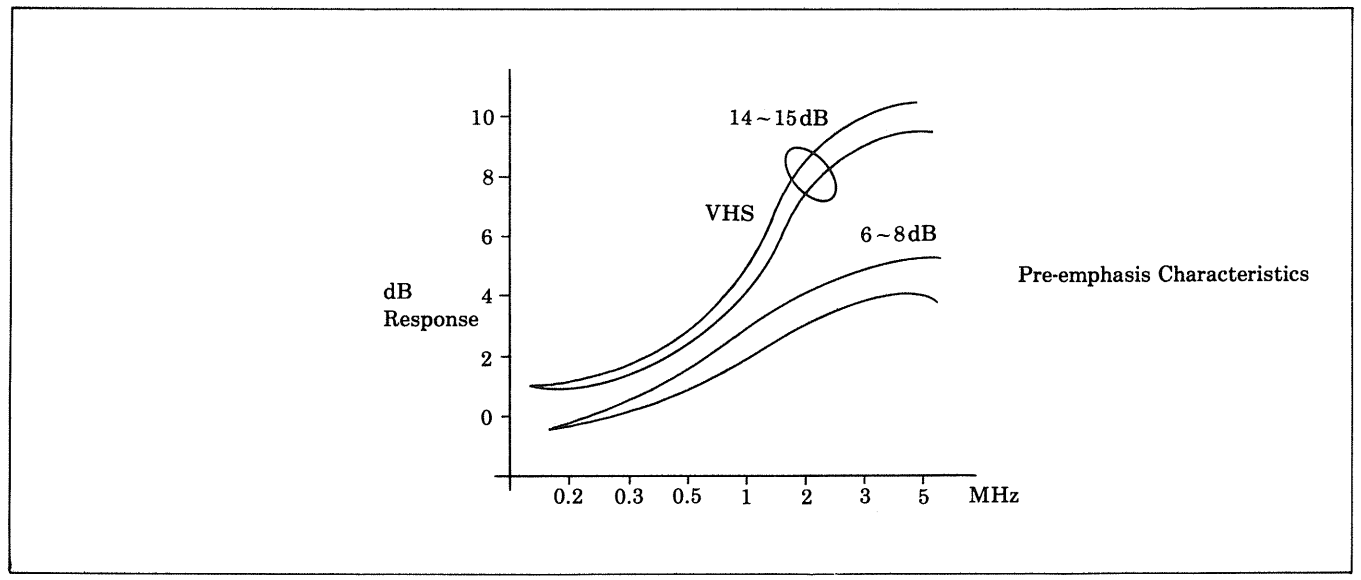



Fig. 88

The signal is clamped by using separated sync in the clamp stage. This action assigns sync tip to a specific DC level.

The signal from pin (12) of IC1 is supplied to the low frequency AMP which consists of Q12, Q13. The output of this stage goes into pin (15) of IC1. The feedback action boosts the high frequency components by attenuating the low frequency components.

The video signal from pin (12) of IC1 is clipped to remove unwanted overshoot caused by emphasis. The white clip circuit consists of Q14 and Q15. The Dark clip circuit which consists of Q16 and D7, performes the same kind of clipping action but an undershoots caused by emphasis.

Next, the video signal enters the FM modulator stage between pin (13) and (14) of IC1.

The FM modulated video signal exits from pin (9) of IC1.

B/W Color Switching

When the carrier of the FM modulator swings from 3.4MHz to 4.4MHz, sidebands are also produced. This can be represented on a spectral graph.

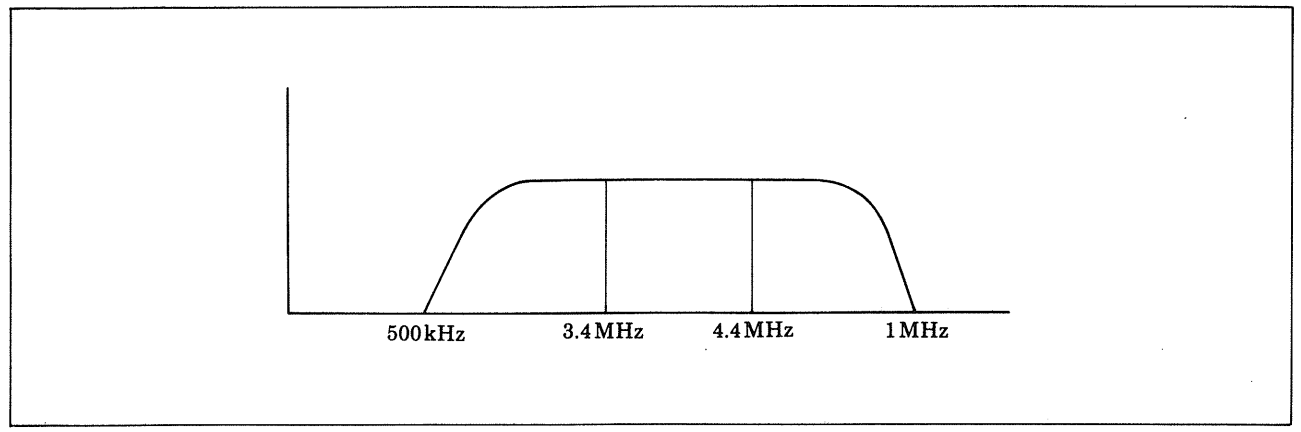



Fig. 89

Notice that the lower sideband extends down to (and below) 500KHz.

When recording color signals, the lower FM sideband must be removed.

This is accomplished by a high-pass filter.

In the B/W mode, there is no need to cut off or band limit the FM sidebands.

In the B/W mode, no +9V signal appears at the base of Q4, so the normal bias applied to Q3 allows Q3 to turn on, keeping Q4 off.

Thus the input to Q3 is passed to its emitter and to the output. The input to Q3 is the unfiltered FM signal.

In the color mode, Q4 receives at its base the +9V ACK color switching signal.

This +9V signal allows Q4 to be forward biased even harder than Q3. So Q4 turns on keeping Q3 off.

Notice that the input to Q4 is through a high pass filter which consists of C10, C11, L6, R22, L7 and C12.

This high-pass filter cuts off the lower sideband.

Both the FM signal and 629KHz color signal are applied to the FM Amp. circuit at the same time, so they must be mixed before final amplification.

The FM and color signals are mixed at the base of Q6. Q6, Q7 form a feedback amplifier whose response is intentionally not flat.

The gain at 1MHz is greater than the gain at 4.4MHz. This is to compensate for certain inherant video head characteristics, especially since they were specfially designed to operate at and above 4.4MHz.

The output of the record amplifeer is only useful when actually recording

Q10 acts as a REC/PLAY switch by grounding the FM feed side of the heads during playback.

## LUMINANCE PLAYBACK PROCESS

### General Description

The simplified block diagram for the Luminance Playback Process is shown below:

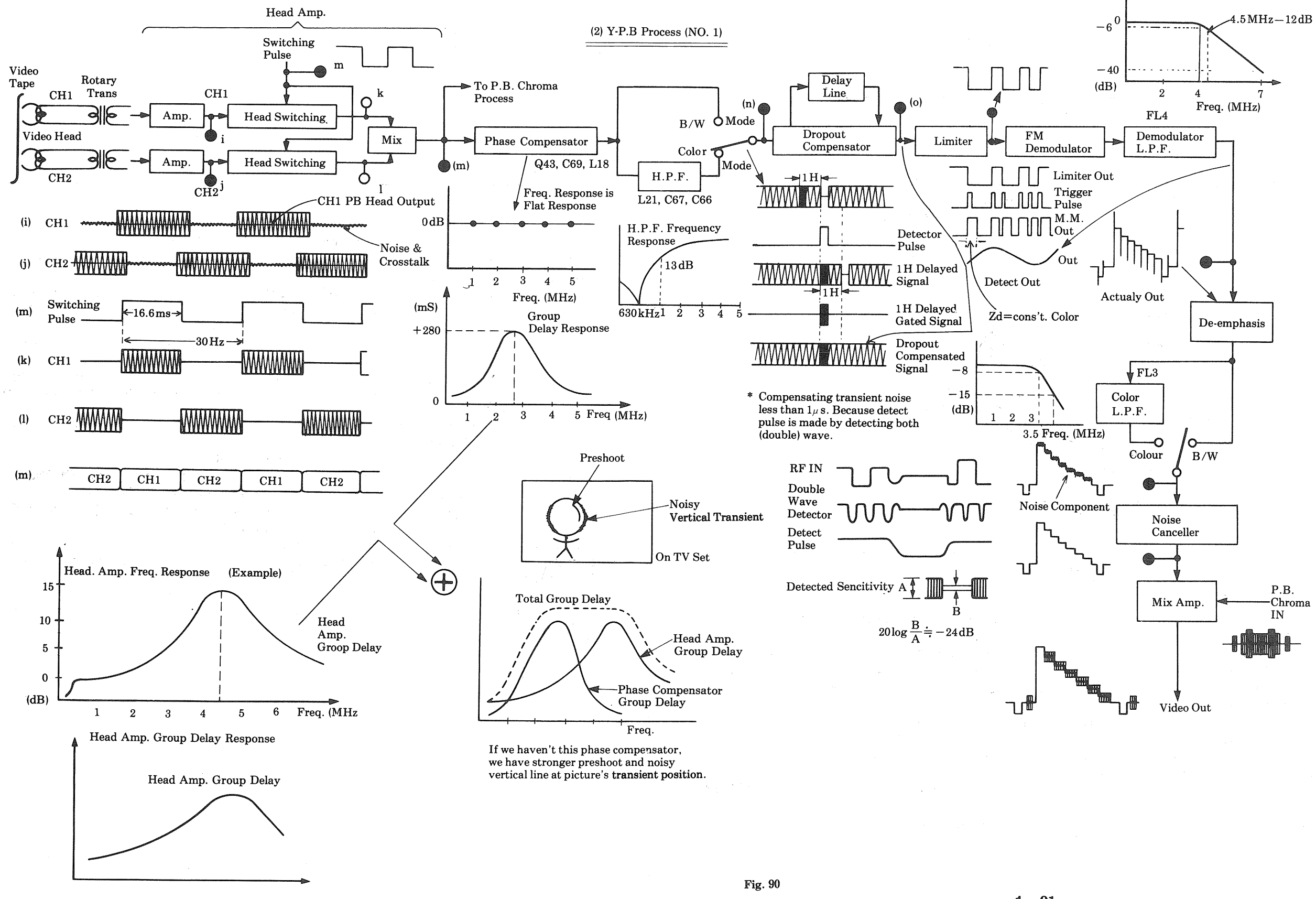



Fig. 90

PLAYBACK PROCESS

* Head Amp & Head Switching (IC3)

In the recording process, a video signal (Y: 3.4M-4.4M FM, C: 629KHz) was recorded by two video heads which are located on the upper cylinder exactly 180° apart each other.

To prevent noise from appearing at the switching portions, in playback the tape is wrapped around the cylinder more than 180° as shown below.

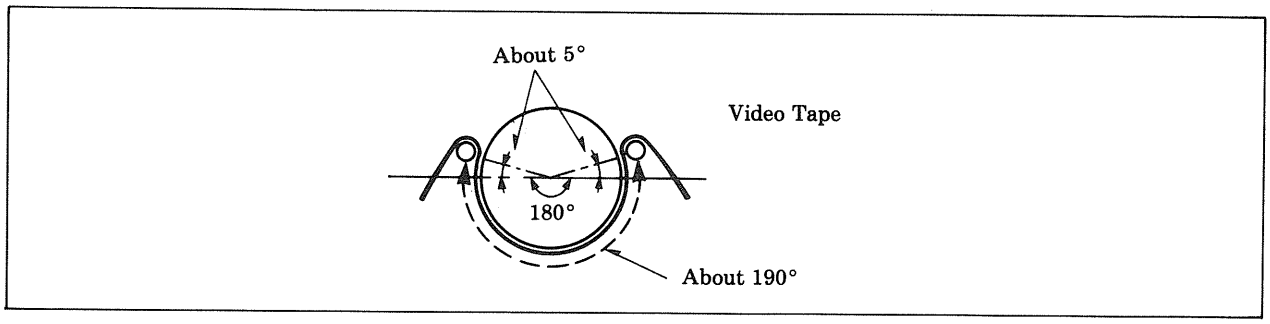



Fig. 91

A switching circuit will be required to turn off the video head which is not in contact with the tape.

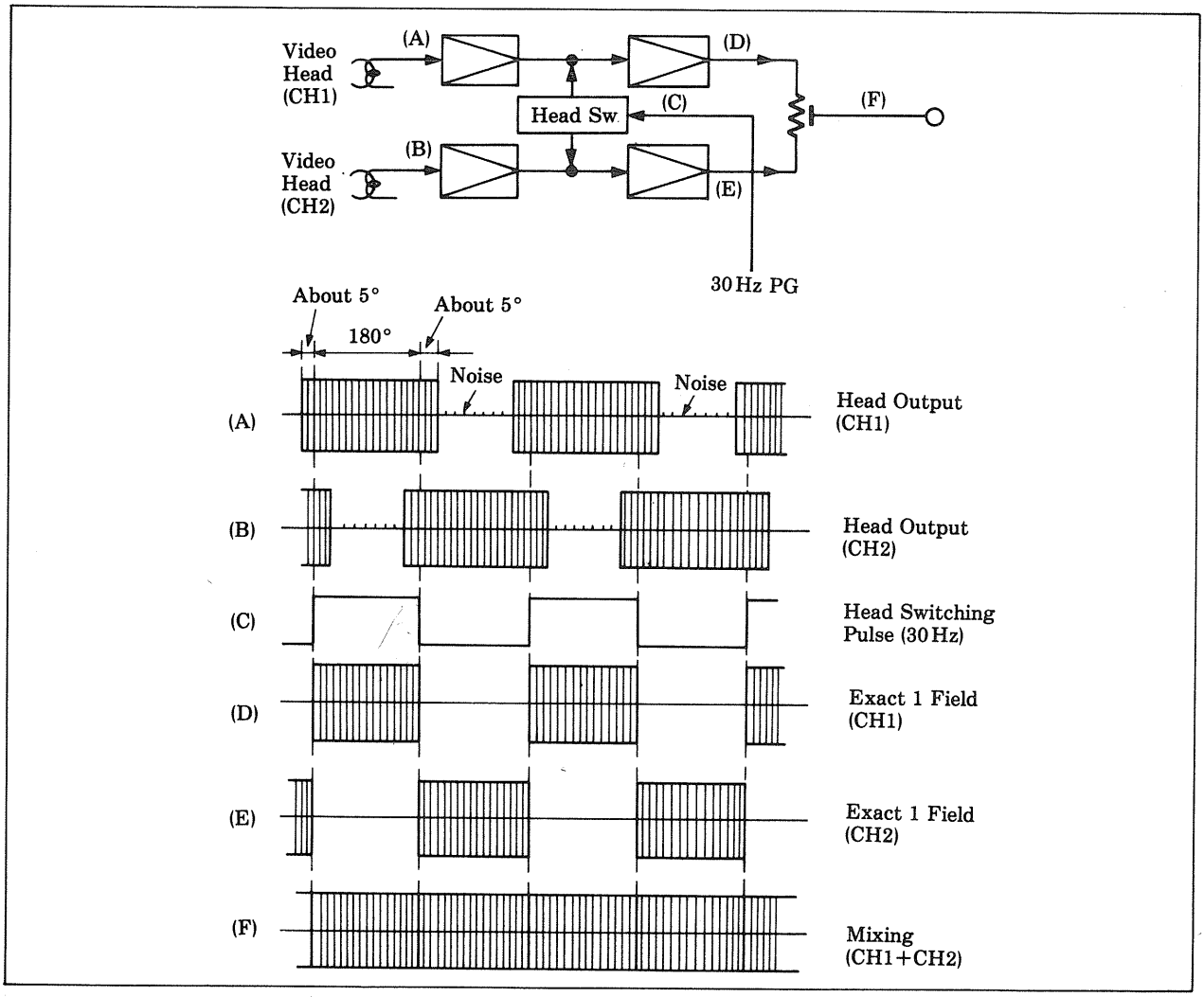



Fig. 92

* RF Out from Head Amp

The RF Output is sent to Phase Compensator (Q43, C69, L18) for compensation of Head Amp Group Delay (Refer to Item 5 of Main Features), L.P.F. for 629KHz Chroma separation.

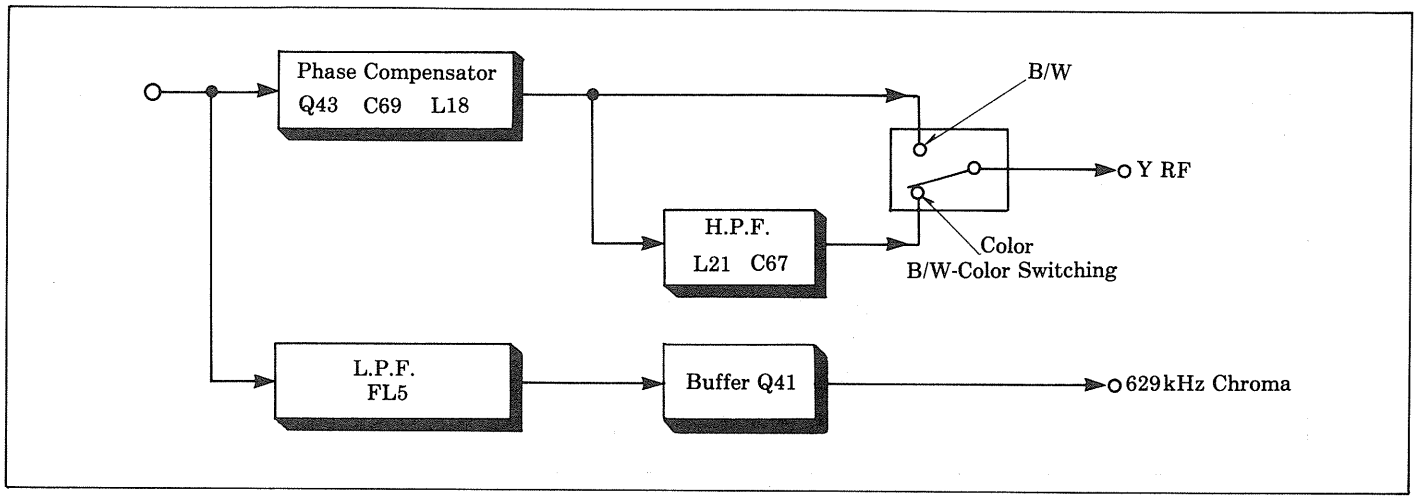



Fig. 93

* Drop Out Compensator

If drop out occurs, the missing portion will be compensated by the 1H delayed signal.

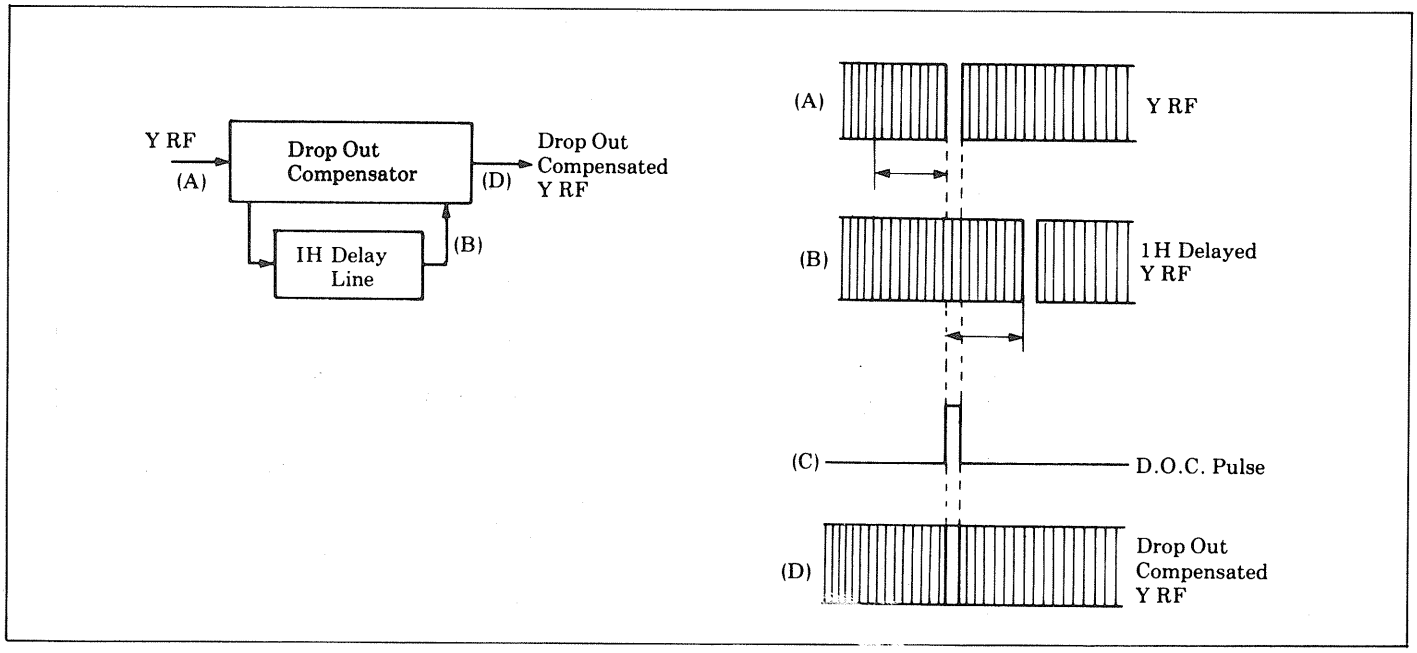



Fig. 94

* FM Demodulator

The compensated RF signal is then Limited and sent to the FM Demodulator.

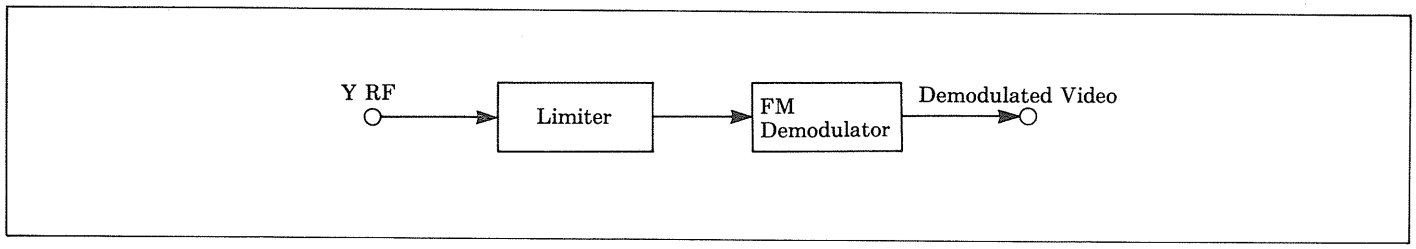



Fig. 95

Demodulation of the RF signal to video is described below.

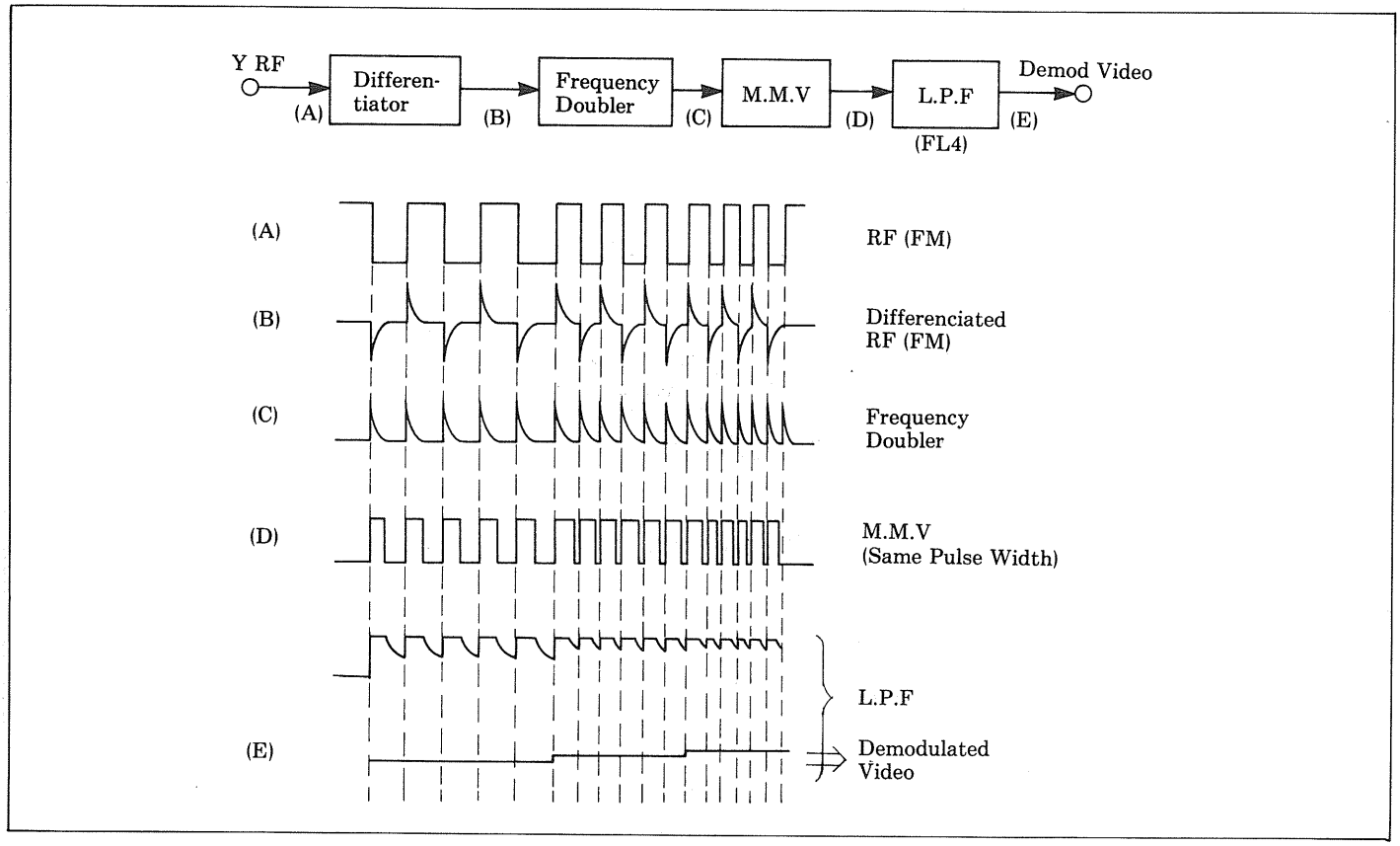



Fig. 96

Deemphasis

In the Record process, the video signal was pre-emphasized. Therefore, in the Playback process, it should be de-emphasized.
The relationship between pre-emphasis and de-emphasis is shown below.

RECORD(Pre-emphasis) PLAYBACK(De-emphasis)

* Noise Canceller

The purpose of the noise canceller is to improve overall signal to noise ratio and works in the following way. Generally speaking, noise lies in the high frequency region, and its amplitude is fairly low. If the signal is split, with one path high pass filtered, inverted and limited; it can be added back into the signal to cancel same random noise.

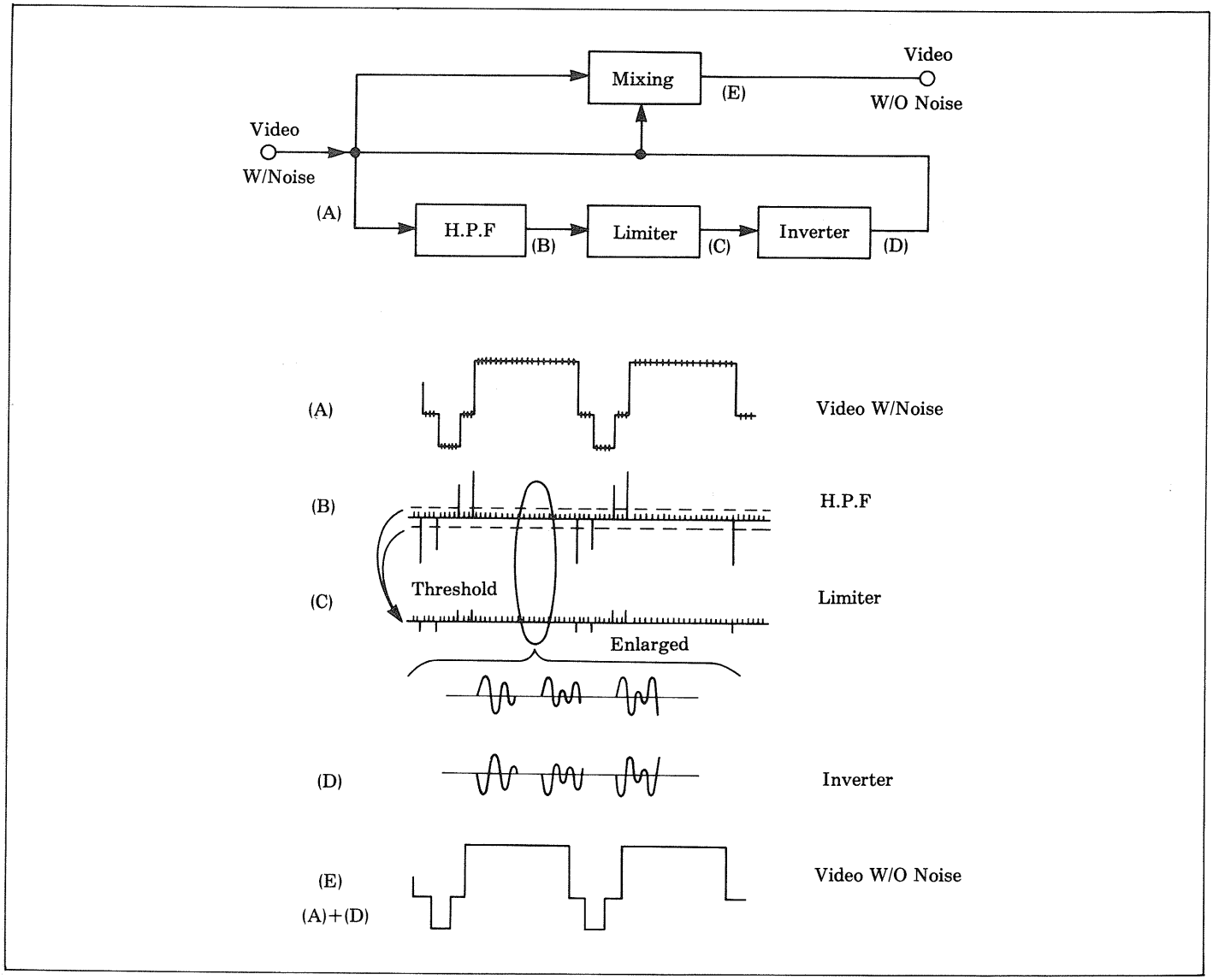



Fig. 97

* Y-C Mixing Circuit

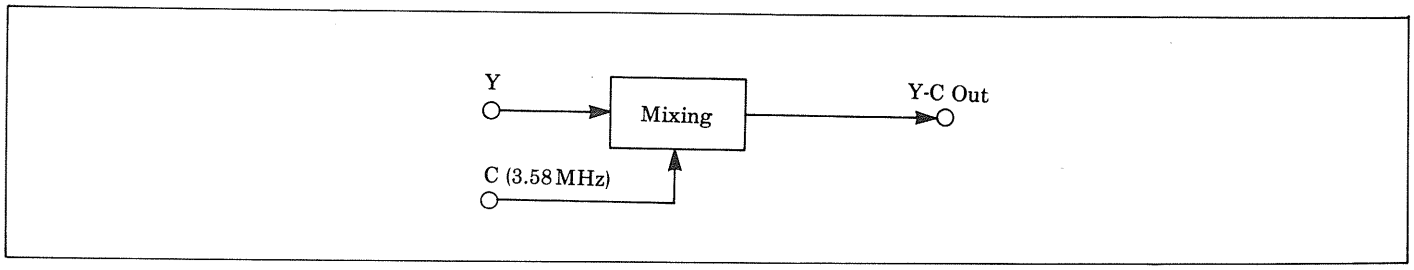



Fig. 98

## General Description

The first process in the playback mode is that of signal recovery off the tape. The video heads spin and sweep across the tape as they deliver an FM and 629KHz signal to the playback amplifiers and peaking controls.

## Peaking Controls

The peak frequency, i.e., the frequency at which the heads deliver a maximum output, is adjustable by a trimming capacitor at the input to each playback amplifier. The peak frequency is adjusted to be 4.5MHz, and this provides optimum operation of the playback circuits.

## Playback Amplifiers

The video heads deliver their signals to their respective playback amplifiers. The amplifiers inside of IC provide sufficient gain to drive the rest of the tuned circuits. A feedback path from the output of each AMP to the input provides a "Q" adjustment. This adjusts the frequency response, but more precisely, the shape of the response curve centered around the peak frequency.

## Q Adjustment

The Q adjustment changes the shape of the playback frequency response curve in relation to the peak frequency.
The Q is adjusted so that the level of the peak frequency, 4.5MHz, is 2.3 times as great as the level of the 2MHz playback response.

## Head Switching

Its been pointed out before that only the video head actually in contact with the tape need provide an output during playback. The head not contacting the tape is picking up noise, so that the channel for this head can be shorted to ground to prevent noise in the output signal.
Head switching is the shorting to ground of the signal out of the channel whose video head is not contacting the tape. The A and B channels are alternately switched on and off 60 times per second.
The PG pulse, or head switching pulse, produced by the servo circuits is used for the switching. The pulse is actually a square wave, positive or high for the A head, and zero or low for the B head.

## FM Mix

The outputs from the A and B channels are mixed across the fixed resistance leads of a potentiometer.
The wiper then selects the balance between the two channels.

## 65KHz Trap

In the event of audio dubbing, the video heads are in the playback mode, while the audio head is recording.
As the video heads spin, they may pick up some audio bias signal which can radiate from the audio erase head.
The audio trap will keep any audio bias signal picked up by the video heads from appearing at the output of FM mixer.

B/W Color Switch

Just like in the recording process, several areas of the playback circuitry will use B/W Color switches.
The reason is the same--in the color mode, information off the tape in the region of 629KHz is color information only, and this information should not be processed by the luminance circuits.
In the B/W mode, the lower sideband of the FM signal may very well extend down to the color region, so for improved resolution, the luminance circuits are allowed to use this information.
In the color mode, then, some extra filtering must be performed.

Dropout Compensator

All VTR's incorporate some form of dropout compensation. Dropout is actually a momentary loss of playback RF signal whether it is due to dirt on the tape or heads, or missing oxide, etc.
Uncompensated dropout produces white or black streaks in the picture which represent the missing information.
The form of compensation most often taken, and employed here, is to substitute for that missing piece of information the last good piece of information that was already played.
For instance, assume that during playback, everything is fine until horizontal line 50 is reached. Further assume that due to a dropout, most of line 50 is missing. What the compensator does is to repeat line 49 instead of passing the noisy line 50. Line 50. Line 49 can be repeated a maximum of 3 times.
The final output of the compensator is constantly being fed to a delay line.
Normally, the output of the delay line is not used because when there are no dropouts the RF signal is good, and is passed directly through the mixer to the output.
But in the event of a dropout, the output of the delay line, which is the previous line of good information, is switched through the mixer in place of the direct RF signal. In this condition, the output of the delay line is actually feeding its own input. This is allowed to occur for 3 consecutive horizontal lines before the switch moves back to the direct RF path.
The delay line cannot keep feeding itself for much more than 3 lines before signal deterioration occurs so 3 consecutive lines is set to be the maximum.
The use of the dropout compensator produces a much cleaner looking picture.

FM Demodulator

After the signal has been dropout compensated, it is ready to be limited and demodulated into a video signal. The demodulation process is performed by IC2, the FM demodulator, and few external components.
Two limiter balance adjustments are provided so that the demodulation process can be kept as clean as possible.

Low-Pass Filter

The final output of the demodulator is not an actual video waveform, but rather a pulse train whose pulse internal is proportional to the desired video signal.
Low-pass filtering this pulse train signal reconstitutes the video waveform.
Low pass filter FL4 is used for this purpose.

De-Emphasis

Because the video signal was emphasized in the recording process, it must now be de-emphasized in playback. A simple R-C network performs this action.

Noise Cancellation

Before the playback luminance signal is mixed with the playback chrominance signal, it is processed by a noise canceller which eliminates some high frequency noise. This is performed inside of IC2, AN6331, by splitting the luminance signal into 2 paths.
The first path is un processed. The second path is high pass filtered, limited and then is subtracted from the first path. This process gives an overall improvement of the luminance signal to noise ratio.

Y-C Mixing

The final stage of playback process is the combination of the playback luminance and chrominance signals.
Inside of IC2, AN6331, the signals are mixed, clamped, amplified, and exit the IC as the playback video signal.

Video Head Current Flow

Detailed Description

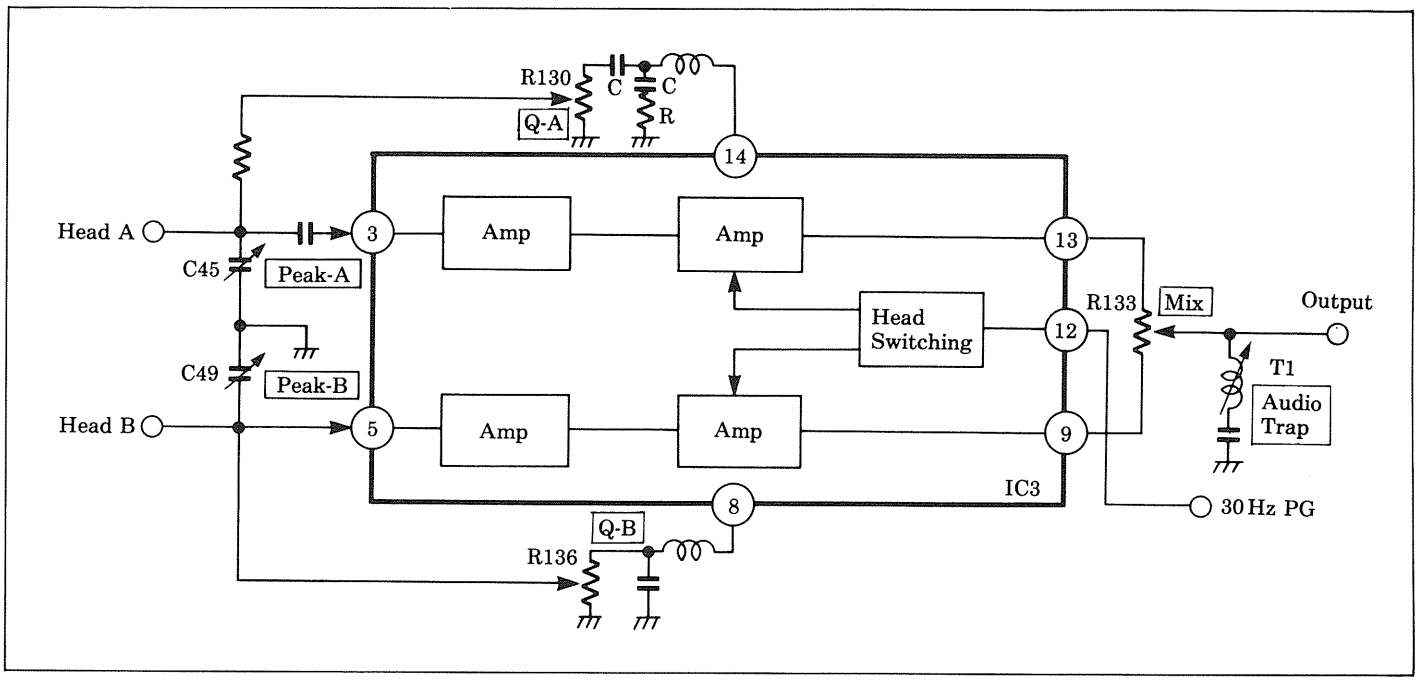



Fig. 99

For Playback, the video heads must be switched so that one side of the head wiring is AC grounded, and the other side is applied to the amplifiers inside of IC3.
The A and B channels are alternately turned off and on so that only one channel provides an output at a time.
Refer to page 1-92.

Peak Control

The video heads are asked to record, and playback frequencies in excess of 4.4MHz. Not every single video head made has the exact same frequency response as any other head. It is important that 2 video heads in the unit have as similar a response as possible. This assumes that each head channel will produce nearly identical signals which produces the best pictures.
Also, the video heads and their respective amplifiers should exhibit a specific frequency response characteristic in order to allow the unit to operate at maximum signal to noise ratio, best overall playback response, etc., all within the basic design limitations.
This is why each video head has an adjustable peak frequency--for head matching, and response contouring. Although the explanation is written for just one channel, it applies to both. Reference is made to the A channel.
The 1st and 2nd amplifiers inside of IC3 are affected by the setting of the peak control, C45. The peak control is adjusted so that the output of the video head at 4.5MHz becomes maximum.
The signal then enters IC3 via Pin (3). The Output of the wide band amplifier appears at Pins (13) and (14).
A portion of the output is selected by R130, Q-A, and is fed back to the input. Adjusting R130 changes the response curve of the amplifier. It does not alter the peak frequency but rather the gain of the amplifier around the peak frequency.

Properly adjusted, the gain of the amplifier at the peak frequency should be 2.3 times the gain at 2MHz.
Large deviations from this adjustment can cause distorted pictures by overdriving the playback AMP, or soft pictures due to a lack of higher frequency response.
Except for reference numbers, the identical circuit is used for the B channel.

65KHz Trap

Between the output from FM mixer, R133, and ground, a resonant circuit with an adjustable coil, T1, is connected. This is the 65KHz audio bias trap.
T1 is adjusted so that there is minimum 65KHz pickup by the video heads.
Notice that if the audio trap is poorly adjusted, there is some bias pickup at a 16.6ms rate--as the video heads revolve towards and from the audio head.

Detailed Description

Phase Compensator

Phase compensators are used in several places in the video recording and playback circuits to correct any phase errors introduced by filters or frequency response shapers.
Since the response of the playback RF signal was shaped by the head amplifiers, phase compensation is necessary before further processing.

Phase compensator its associated components Q43, C69, L18 perform the desired action before being passed to IC2.

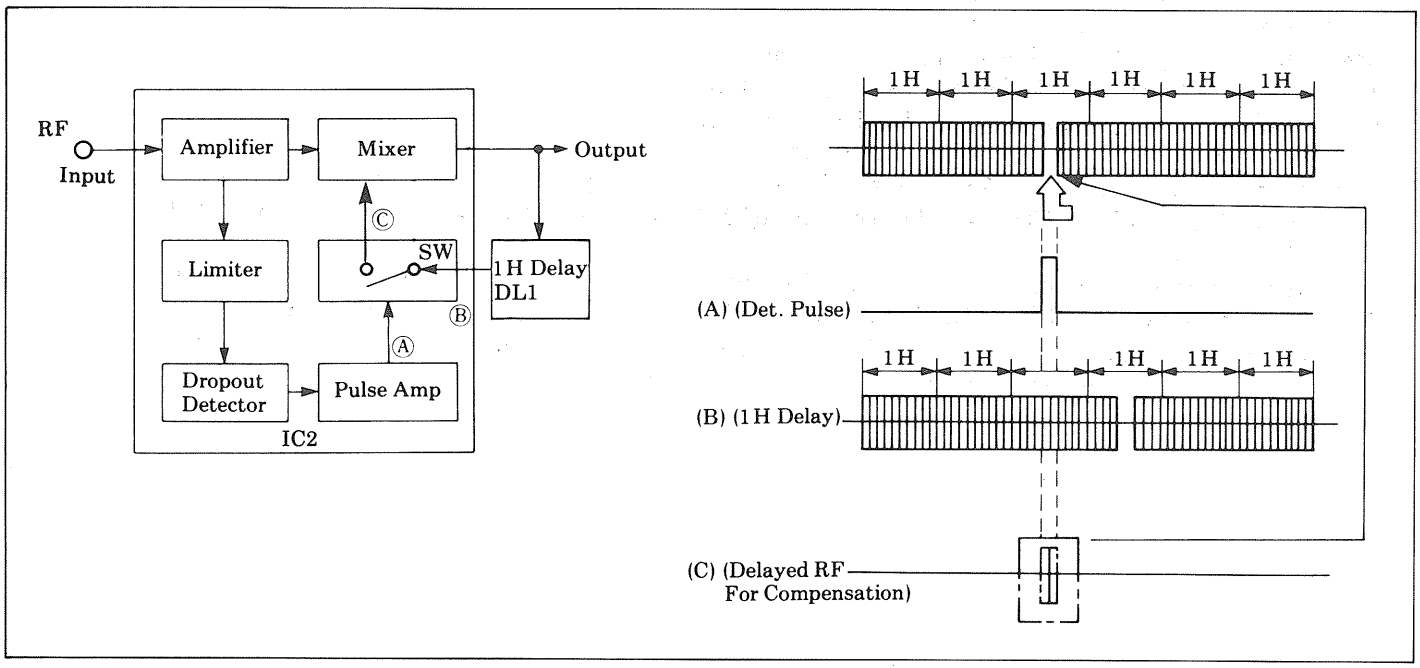



Fig. 100

If a dropout occurs, a positive going pulse appears at point A. This pulse changes the DOC switch so that it selects the delayed signal entering at point C instead of the straight signal. The DOC switch is an electric switch, internal to IC2. The mechanical representation is used for simplicity only.
The pulse which occurs during a dropout is used as a dropout inhibit signal on the color board, and will be covered later.

FM Demodulator

IC2 and its external components make up the FM demodulator.
Before actual demodulation, the signal is limited to remove any amplitude variations in the signal. This is a standard operation in FM demodulation systems. This limiting action is adjustable so that a even, or balanced limiting is accomplished. Uneven limiting can cause an unwanted frequency to be present in the demodulated signal.
Also, demodulation process requires that a signal, slightly shifted from the original, be generated, then both are used for the actual demodulation. The shift is performed by a monostable multivibrator inside of IC.

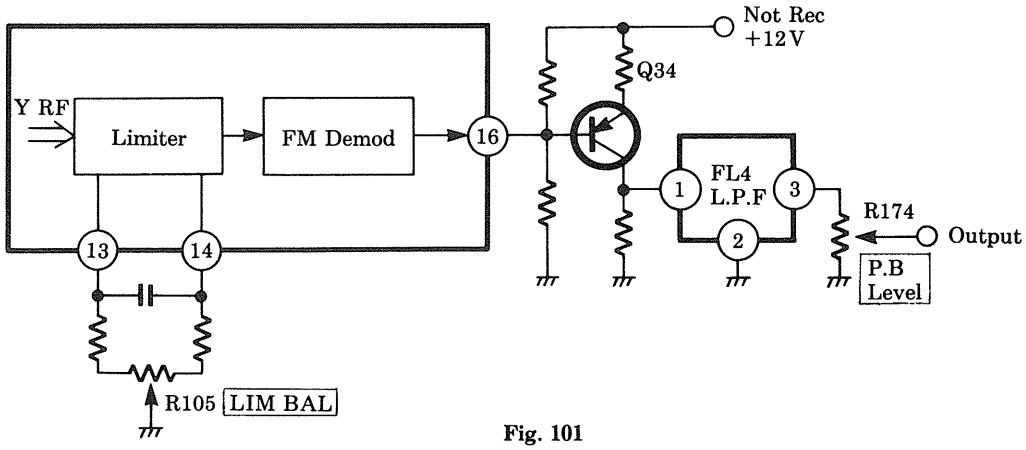



Fig. 101

The DC level of the shifted signal is adjustable with LIM BAL, R105, so that the FM signal should have exact 50-50% duty.
Now the FM signal is demodulated is shown in Fig. 101.
The luminance playback level is adjusted by PB LEVEL, R174.
A second limiting stage, IC4 is incorporated to obtain overall better limiting action, and therefore better pictures.
The dropout compensated RF signal is split. One path is through TP13, low pass filter (C77, R121, L20), amplified by Q30,35 and routed back to IC2, pin (14) for limiting.
The other path is through Q37, 38 high pass filter (C112, 113, R118), through Q40, and routed to IC4, pin (14) for limiting. The limited signal out of pin (6) is mixed into the emitter of Q35. Thus, there is separat limitting for high frequences and low frequences FM information.

De-emphasis, Sync & Smear Compensations

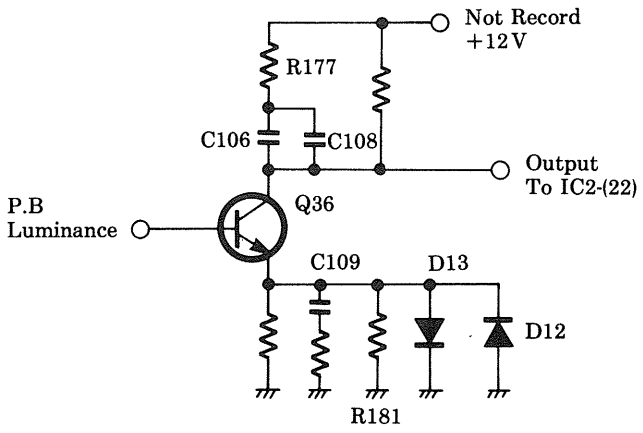



Fig. 102

* De-emphasis

The demodulated video signal still has emphasis imposed upon it which it received in the recording mode.
De-emphasis must be performed to obtain the normal video signal. R177, C106 and C108 form the de-emphasis network.

* Smear Compensation

To prevent smear from appearing, smear compensation is performed by C106, R181, D12 and D13.

Noise Canceller

To improve even more the overall S/N ratio, a playback noise canceller is used.

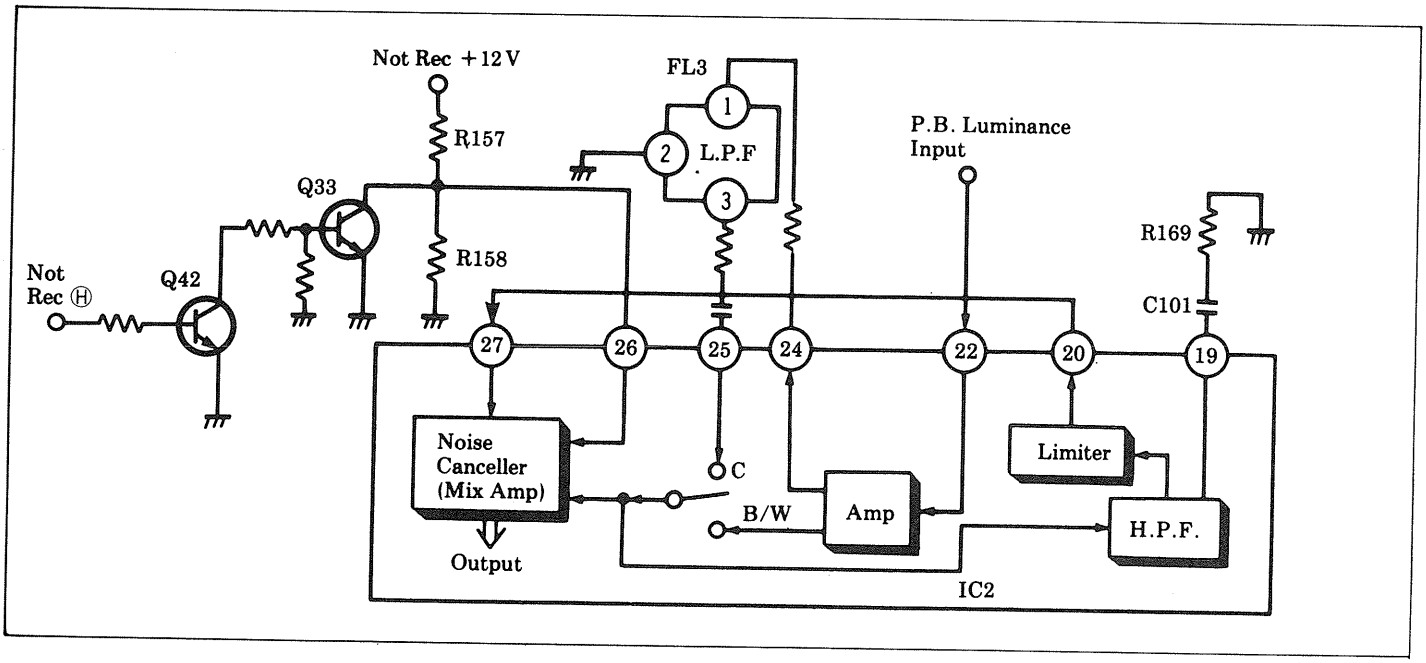



Fig. 103

The action of noise cancellation is only necessary when actually playing back--thats when system noise can arise. In the record, or E-E mode, IC2 handles the E-E signal which does not require noise cancellation. With this in mind, IC2 will be examined.
The playback signal enters IC2 on Pin (22). It is amplified and sent to two places: out of the IC through Pin (24) and internally to the B/W-Color switching circuit, B/W side. The signal which appears on Pin (24) is sent to the low pass filter. This low-pass filter will remove energy above about 3MHz (for use in the color mode to eliminate any signals near 3.58MHz) The output of the low pass filter is applied to pin (25). Either the filtered signal (color mode) or the unfiltered signal ( B/W mode) will appear of the common of the B/W color switch inside the IC.
Here, it is split two ways. One path is unaltered. The other path is high-pass filtered and limited, inverted and routed out pin (20) back in to pin (27). The filtered - limited signal is inverted and added to the unaltered path. This action reduces some of the random noise.

CHROMINANCE RECORDING PROCESS

General Description

3.58MHz BAND PASS FILTER

The incoming video signal is sent through a band pass filter so that only the information centered around 3.58MHz (color information) remains.

BURST BOOST (Burst Emphasis)

One method of improving the overall color S/N ratio is to increase the level of just the burst signal by 6dB. The boost circuit is controlled by a burst gate pulse which ensures that just the burst signal, and not the rest of the color signal, is boosted.

ACC

In the ACC (Automatic Color Control) loop inside of IC1, the overall level of incoming burst is kept constant. If for some reason the quality of reception was changed, and the incoming video level dropped slightly, the ACC circuit would increase its gain slightly to compensate. The converse is also true. This circuit functions as a change in burst level occurs. Detecting any change in burst level is the only accurate way to judge a change in the incoming color signal level.

BALANCED MODULATOR 1

This balanced modulator inside of IC1 performs the necessary downconversion and rotation of the chroma signal so that it can be recorded onto the tape.
One input to the balanced modulator is the chrominance signal itself, after ACC. The second input to the balanced modulator is a 4.2MHz phase-locked rotational signal derived from another part of the chrominance board. The output of the balanced modulator is selected to be the difference, or 629kHz which is also phase-locked, with rotary phase.

COLOR KILLER

This section of IC1 either passes or blocks the signal out of burst emphasis. In the color mode, the signal is passed to be amplified and recorded. In the B/W mode, any output from the burst emphasis is blocked, so that it does not contribute any noise to be recorded.

SYNC SEPARATORS

It is necessary to obtain a sync signal from the incoming signal in order for the rest of the chrominance board to function properly. (Sync is also used for servo.)
The E-E signal, in the record mode, from the luminance board is used to obtain the sync signal. The E-E video signal is sent to IC2 where the composite sync signal is separated. This composite sync signal is then sent to IC3, where a horizontal sync only signal is derived. The horizontal sync signal is used by the burst gate pulse generator and AFC circuits.

BURST GATE PULSE GENERATOR

This circuit develops a pulse coincident with the color burst portion of the incoming signal. This pulse can be used by other circuits to gate burst signals. The burst gate pulse generator receives the horizontal sync signal which has been delayed in time so that it is coincident with burst.

The simplified block diagram for the chrominance Record Process is shown below.

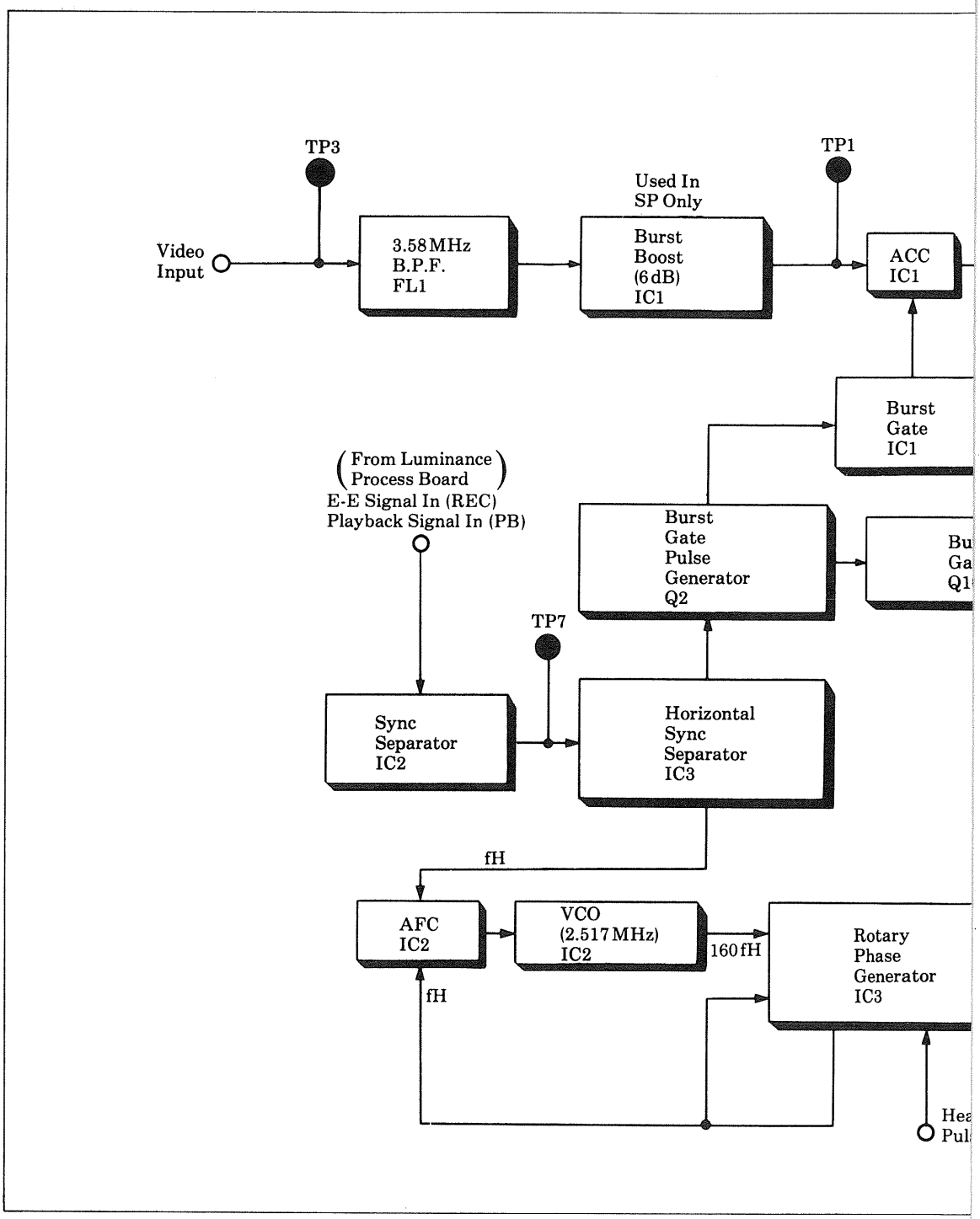
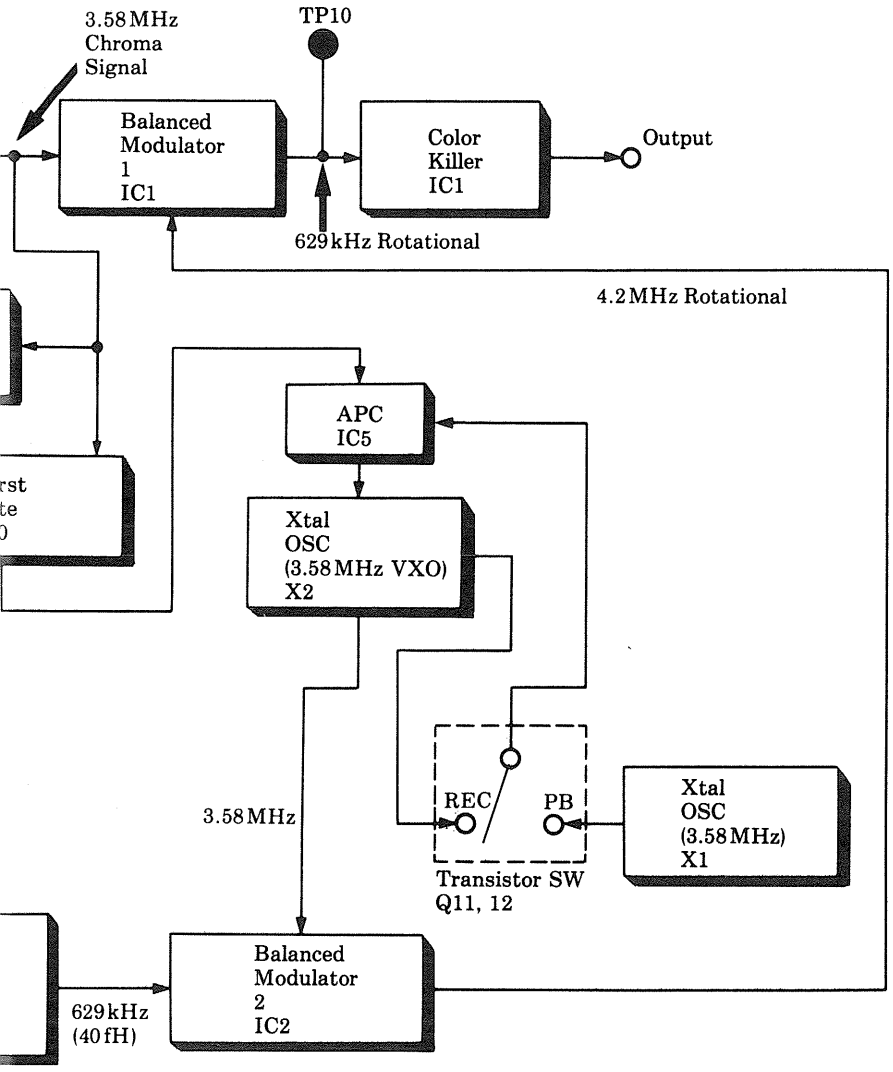



**Fig. 104 Chrominance Proce**




Note: fH (Horizontal Sync Frequency: 15.734kHz)
40fH: 629kHz
160fH: 2.517MHz

ss Block Diagram

3.58MHz Bandpass

The input video signal is bandpass filtered by FL1 on the color board. Therefore, only the color signal and its sidebands are allowed to pass. This signal enters IC1 at pin (3).
In the second mode, this signal is routed to the ACC block.

ACC

ACC detection and control are totally inside IC1. The object is to keep an overall constant color signal level by looking at input color burst.
The ACC block has variable gain and is controlled by the detector block.

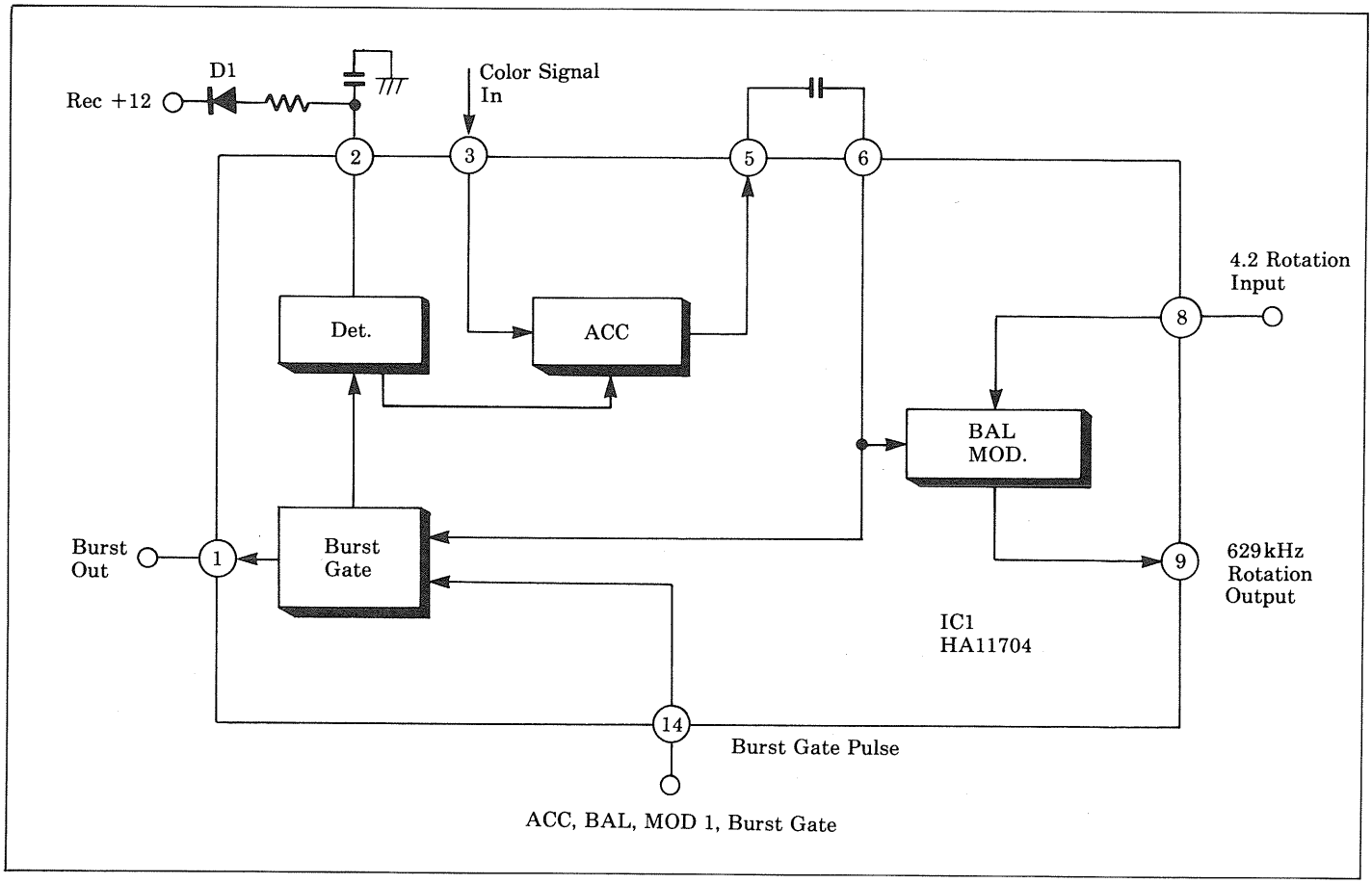



Fig. 106

The color signal in on pin (3) is passed through ACC and is routed eventually to the Burst Gate block. Another input to the Burst Gate block is the burst gate pulse from Q2. Therefore, only the color burst signal is fed to the Detector Block. The detector looks for any change in level and will change the gain of the ACC to compensate.
The response of the detector is changed between Record and PB by the Record +12V signal applied to D1.
The Burst Out signal, pin (1), will be used in the APC section.

The ACC color signal is now applied as one input to balanced modulator 1. Balanced modulator 1 is contained totally inside IC1. There are two inputs and one output. The purpose of this balanced modulator is to produce a 629kHz chroma signal with phase rotation.

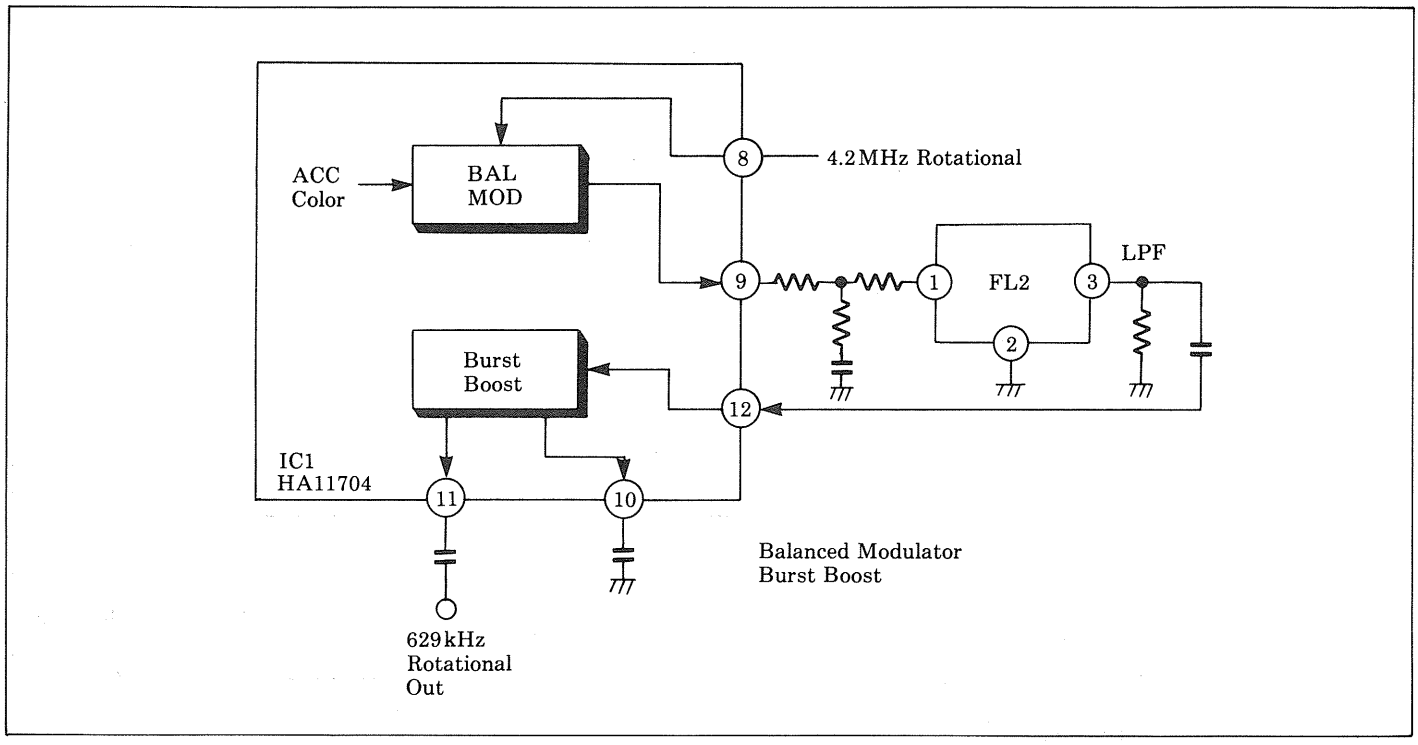



Fig. 107

This means that the second input to this balanced modulator must also have phase rotation, and must be of such a frequency so that the difference between the two input frequencies is the desired output frequency. Therefore, the second input, applied to pin (8), is a 4.2MHz rotational signal. The 4.2MHz signal is a continuous sine wave signal which is phase-locked to the input horizontal sync. The 4.2MHz signal will change its phase by 90° every time a new horizontal sync signal is received. Because one of the inputs to the balanced modulator has a phase rotational characteristic, the output signal will also have the same characteristic. The output of the balanced modulator appears at pin (9). This output contains two bands of information. It will contain the sum and difference of the two input signals. The sum is a 7.8MHz rotational chroma signal. The difference is a 629kHz rotational chroma signal. The sum signal must be eliminated so that it can cause no interference. Therefore, the output from pin (7) is passed through a low-pass filter, FL2, so that the sum signal will no longer be present. The output of the low-pass filter appears at pin (3) of FL2. The derivation of the 4.2MHz rotational signal will be covered later.
The 629kHz rotational color signal is now almost ready to be recorded.
The 629kHz signal is routed back into IC1 through pin (12). Now, in the burst boost section, the level of the burst portion of the signal by 6dB.
This is in accordance with the basic V.HS formats to improve color S/N.
The burst boosted 629kHz signal exits IC1 via pin (11) in the color mode.
In the B/W mode, the color killer (ACK +9V) drops to a low, or 0 volts.
This low, applied to pin (13) will disable the burst emphasis block and there will be no output.
In the color mode, pin (13) recieves 2 VDC to enable the emphasis block.

Burst Gate

The burst gate pulse is a pulse train signal whose positive going pulses are coincident with the burst portion of the color signal. It is used throughout the color circuits so that the burst signal can be separated from the chrominance signal.

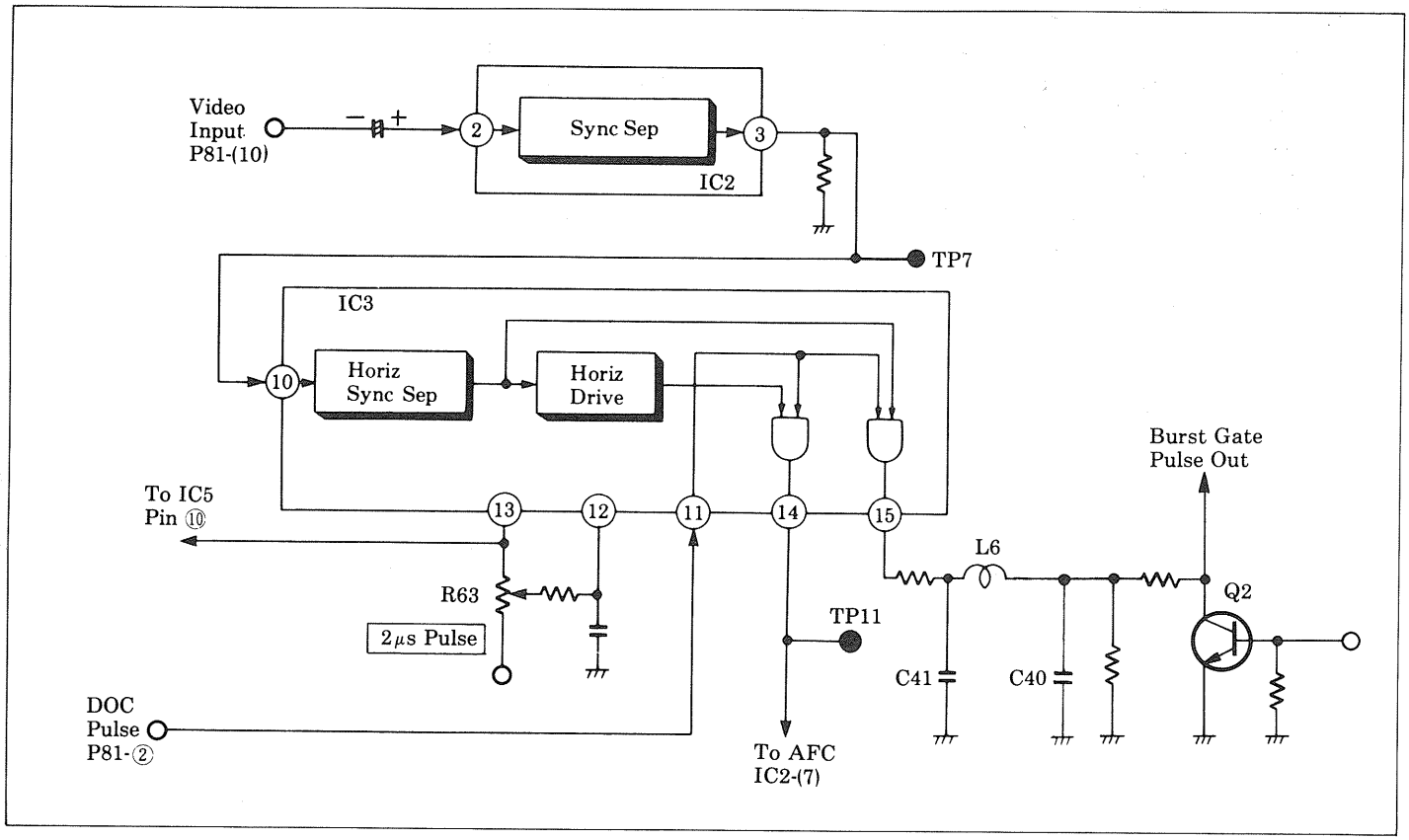



**Fig. 108 Burst Gate Circuit**

The input video signal is applied to IC2, pin (2) through connector P81-(10). Internal to IC2 is a composite sync separator.
The composite sync signal leaves IC2 through pin (3). The signal is then sent to IC3 entering on pin (10). Inside of IC3, is a horizontal sync separator, and a horizontal drive generator. The outputs from this portion of IC3, from pins (14) and (15), are positive going pulses.
These pulses have the same timing as horizontal sync. These pulses also have an adjustable width. This adjustment, R63, is located between pins (12) and (13). This adjustment is called the 2μs pulse adjustment.
The output from pin (14) is used in the AFC circuitry. This signal can also be seen at TP.11. The other output at pin (15), is sent to the collector of Q2 through a delay circuit consisting of C41, C40 and L6. This delay circuit delays the pulses so that they coincide with the burst signal. The burst gate pulse output signal is obtained at the collector of Q2.
From connector P81 pin (1), the head switching signal is applied to the base of Q2. When head switching occurs (rising or folling transition) Q2 will short the burst gate signal to glowed for about 8-9 h. This will prohibit the burst gate signal from reaching IC1.
Normally, the gated burst exits pin (1) of IC1 and is sent to Q10 and is eventually used for comprison in APC. When the burst gate signal is grounded (at head switching) the APC comparison signal is missing.
So, the APC loop will not respond at the time of head switching. This is desirable in playback because there is a greater chance of time basic error at head switching and the APC should not be allowed to "over react"-because it may take larger to lock up again.

Derivation of 4.21MHz Rotational Signal

The development of the 4.21MHz rotational signal utilizes most of the circuitly of the chrominance board. Since the 4.21MHz signal is phase-locked to the incoming video signal, two comparator circuits, AFC and APC, are used as phase-locked loops. In brief, the AFC circuit produces a 2.517MHz signal which is counted down and converted into 629kHz rotational signal. On the other hand, the APC circuit, generated a 3.58MHz signal which, when multiplied by the 629kHz rotational signal inside a balanced modulator, will produce the desired 4.21MHz rotational signal.

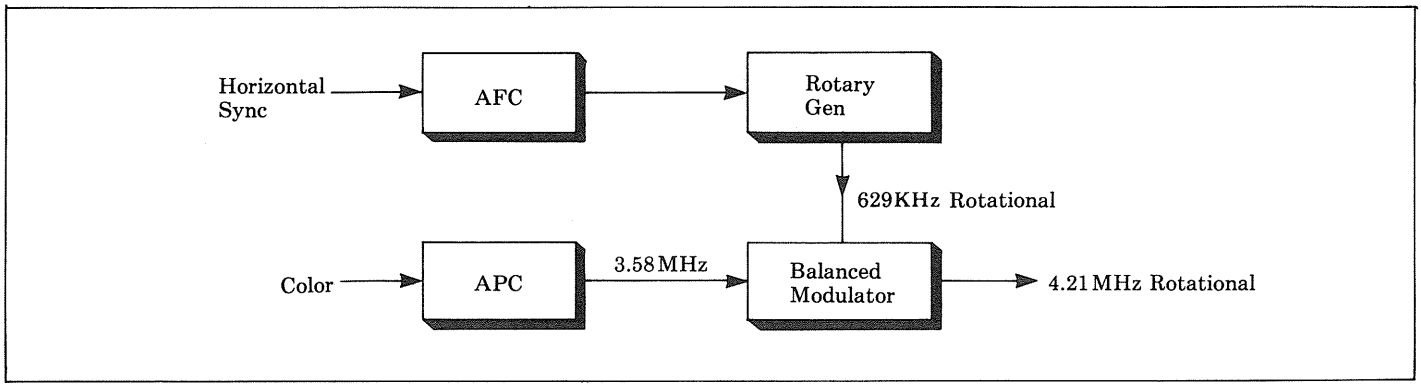



Fig. 109

This simplified description can be seen in the Fig. above. The AFC circuits lock up to incoming horizontal sync, and produce an output signal which is a 2.517MHz signal. This signal is then sent to the rotary generator circuit which produces a 629kHz rotational signal.

Again, "rotational" indicates a phase change of 90° per horizontal line. The APC circuit locks up to the incoming color burst signal and produces an output which is a continuous 3.58MHz signal. The 629kHz rotational signal and the 3.58MHz signal are combined in a balanced modulator, and the output is a 4.21MHz rotational signal. This 4.21MHz rotational signal is the signal that is used in balanced modulator inside of IC1.

The AFC and rotary generator circuits function together. This operation will now be shown.

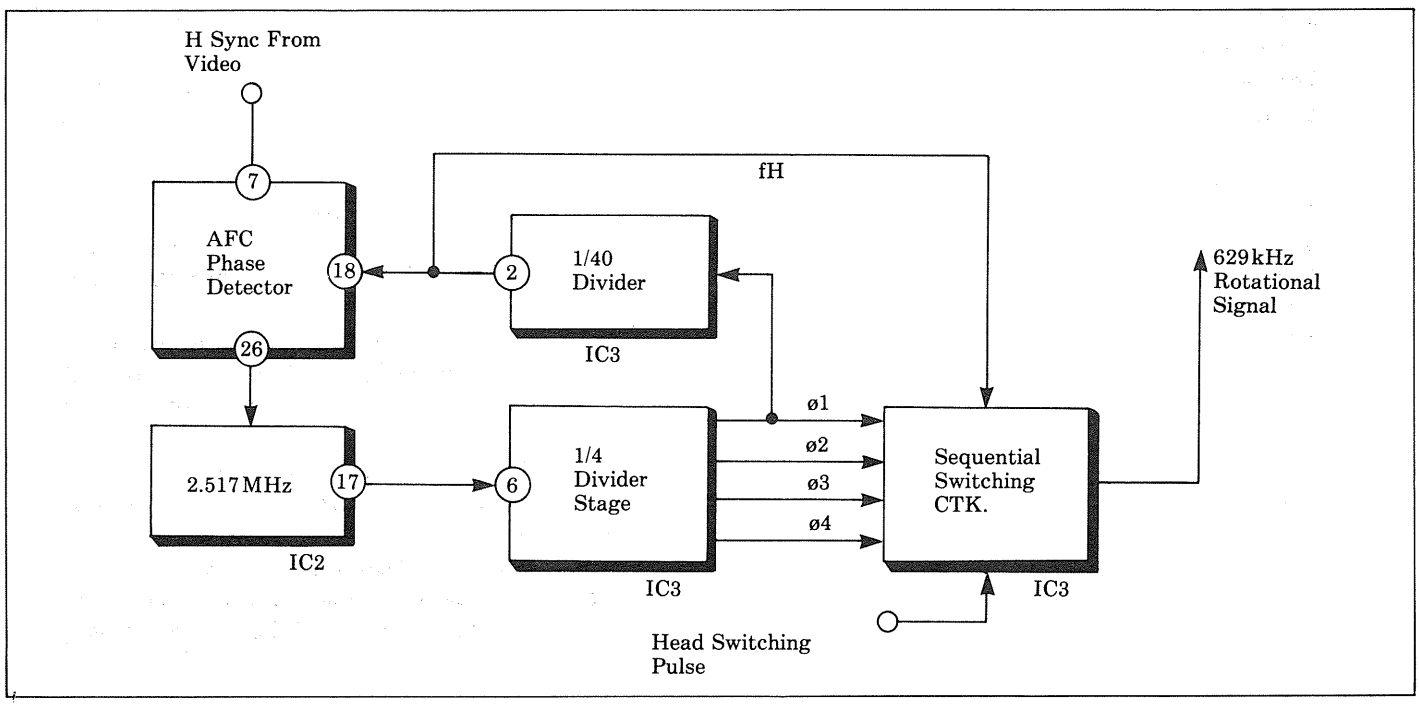



Fig. 110

The AFC circuit, inside of IC2, consists mainly of 2.517MHz VCO, and a phase comparator.
The 2.517MHz VCO output from pin (17) is applied to pin (6) of IC3, the Rotary Phase Generator. The first section inside of IC3. Then produces four simultaneous square wave outputs, each at 630kHz, at 0°, 90°, 180°, 270°. The 0° signal is itself divided down to 15.734kHz. This signal is sent out of IC3 through pin (2). It is then sent to pin (18) of IC2 as one input to the AFC phase detector.
The other input to the phase detector pin (7), is the input video sync signal, here actually the HD signal made by the input sync signal inside of IC3.
IC3's 629KHz signal is phase compared to the incoming sync. Any phase errors will produce an error voltage at pin (26) of IC2.

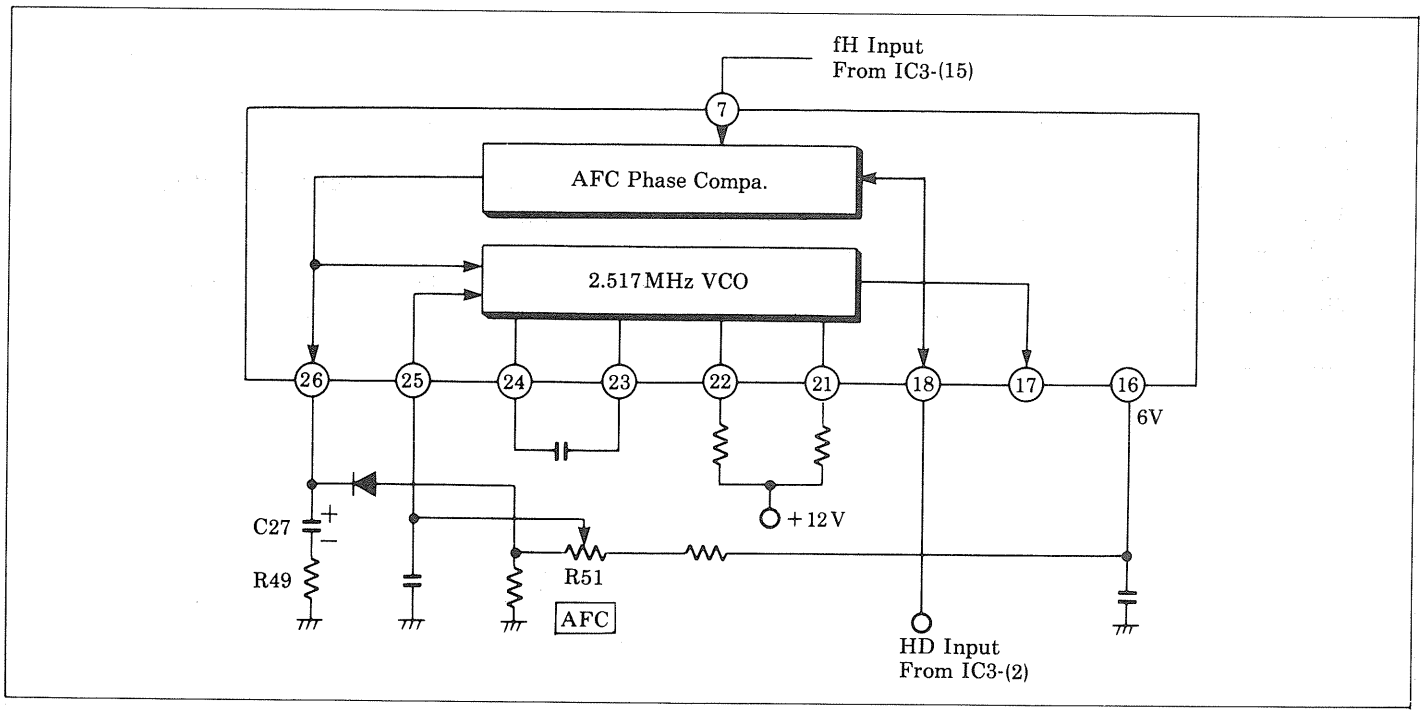



Fig. 111 AFC

The error voltage at IC2 pin (26) is filtered by C27 and R49. This gives the error signal a smoother DC level.
The voltage selected by R51, AFC, is applied to pin (25) and a fixed voltage is applied to pin (26). These two voltages set the operating frequency of the VCO, and the filtered error voltage which rides on top of the fixed voltage at pin (26) will, at any moment, vary this frequency slightly. This is basic VCO action.
If the fH signal from the counted-down 629kHz signal does not phase match the HD signal, an error voltage will be developed and applied to the VCO so that phase matching does occur.
Assuming that the AFC circuit is providing the proper phase-locked 2.517MHz signal, the derivation of the 629kHz rotational signal remains.

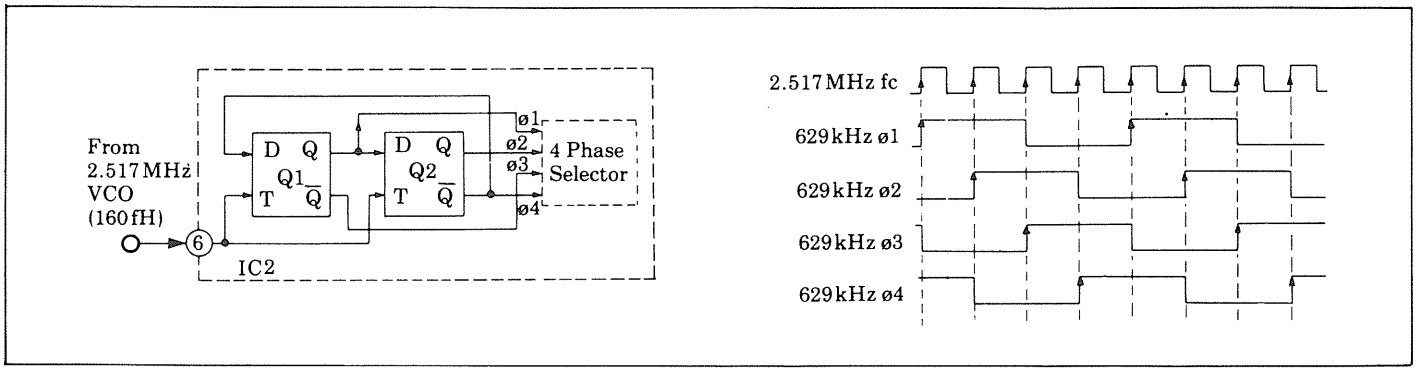



**Fig. 112 Four Phase Divider**

Fig. 112 shows an equivalent block diagram of the divide-by-four stage internal to IC3. The circuit is essentially a ring counter with one input and four outputs. Each output is shifted 90° from an adjacent output at a frequency of 629kHz.
The waveforms of the ring counter are also shown. Since the input 2.517MHz signal is a continuous wave, each output is also continuous.
But, of course, only one will be used at a time.
Each of these four outputs is used as one input to its separate AND gate.
The AND gates are fired in order to provide a phase rotating output.

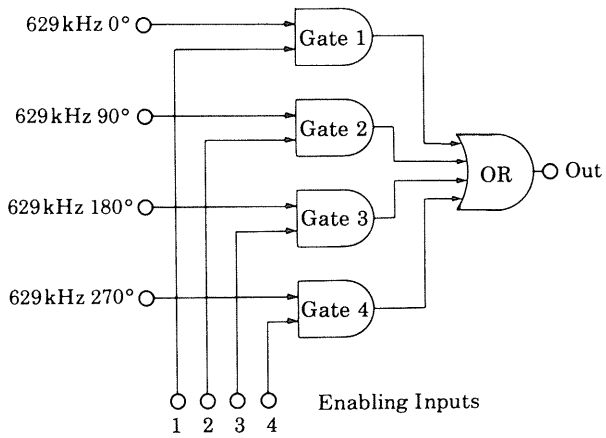



**Fig. 113 629kHz Gating**

To fire the gates in proper order, the enabling input signals must be high in order.
For the first field, for video head "A", the firing order is 1-2-3-4.
This provides the desired 0°, 90°, 180°, 270° etc. rotation.
For the second field, for video head "B", the order is 1-4-3-2. This gives a 0°, 270°, 180°, 90° rotation, which is the same thing as a 0°, minus 90°, minus 180°, minus 270° rotation, which is desired. The enabling input pulses are also generated inside of IC3.

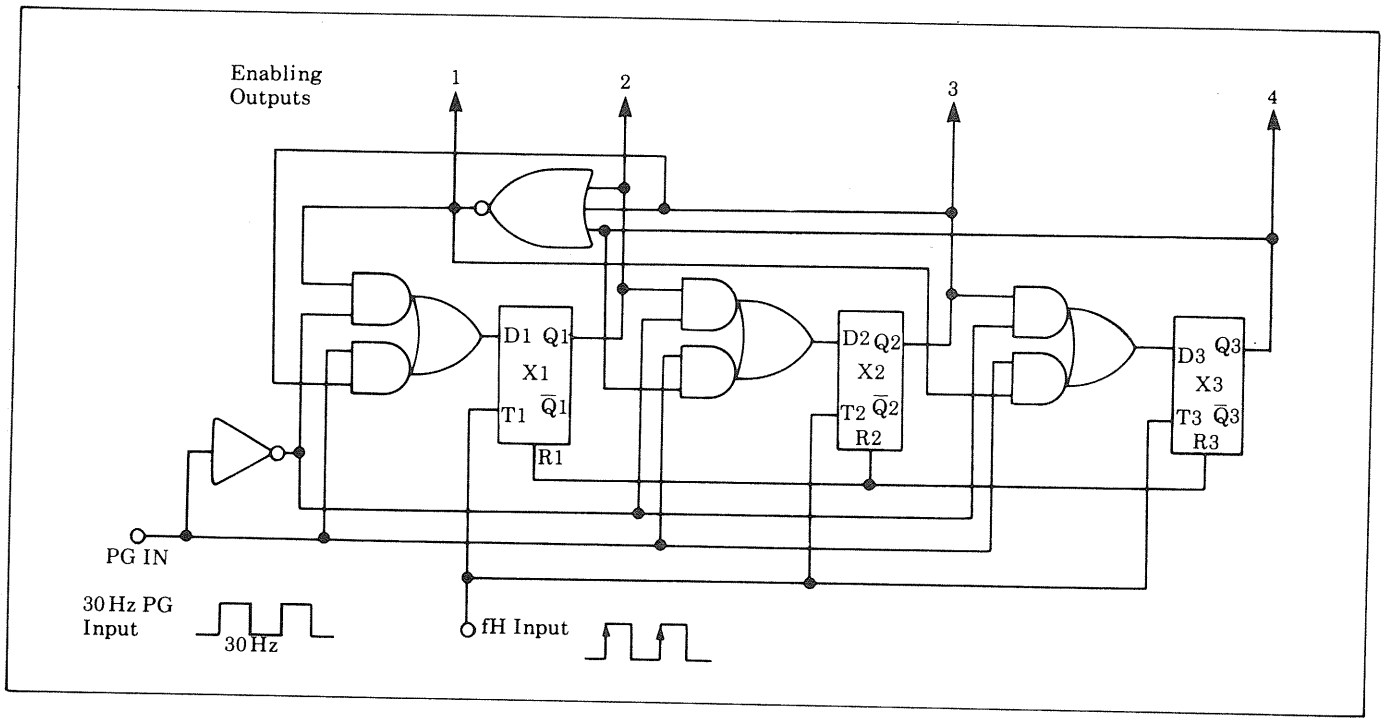



**Fig. 114 Generation of Enabling Pulses**

The counted down 629kHz signal, the fH signal is fed to the fH input. For the first fH pulse, or the first horizontal line of video information, a high signal is present at output one and the rest are low. The succeeding fH pulses will advance the firing order as shown in the waveform below.

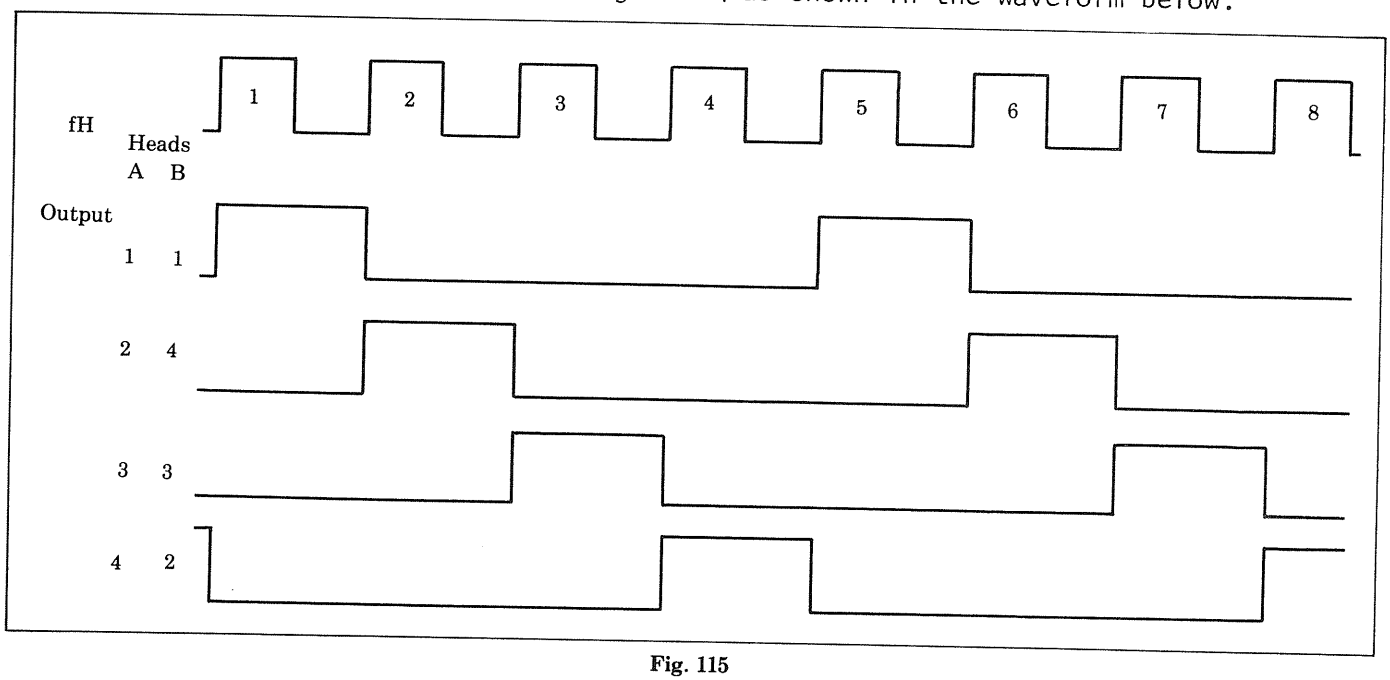



**Fig. 115**

When head "B" contacts the tape, the firing order is changed because of the PG pulse input. The firing order for both heads is shown. The signal 629kHz rotational signal appears at pin (4) of IC3.
The 629kHz rotational signal is used in balanced modulator 2.

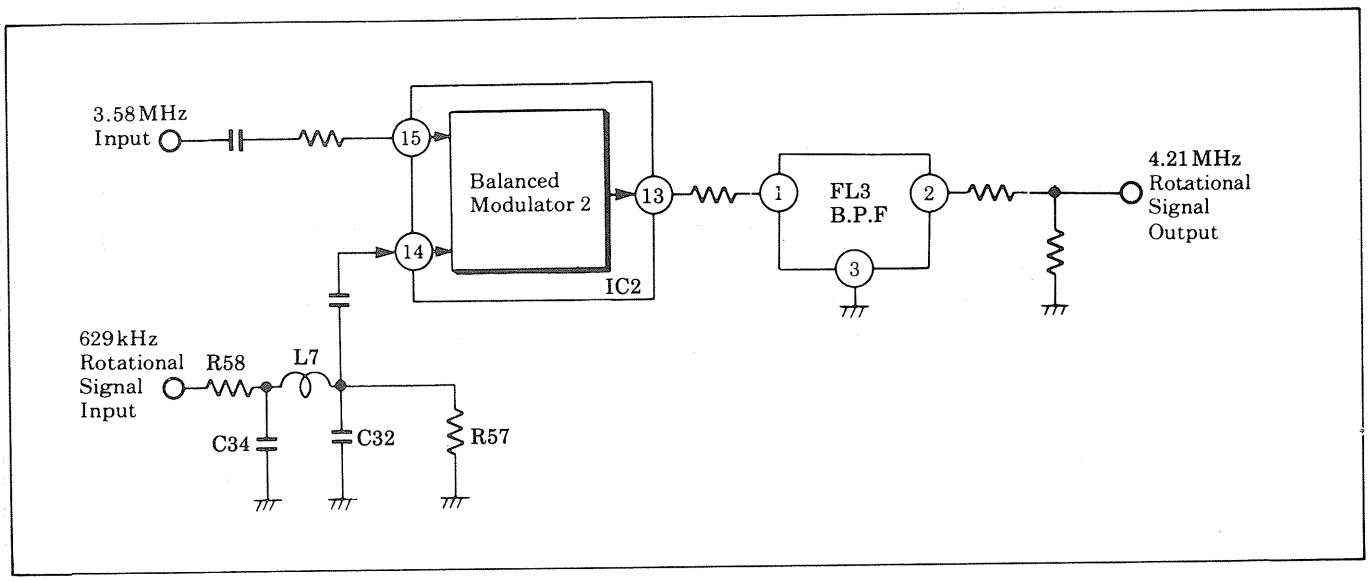



**Fig. 116 Balanced Modulator 2**

The purpose of balanced modulator 2 is to deliver a phase-locked 4.21MHz rotational signal from its 629KHz rotational phase-locked input and its 3.58MHz phase-locked input.
C3 is a digital IC. The 629kHz signal produced by IC3 is a square-wave signal. So before this 629kHz signal can be used in IC2, it must first be low-pass filtered into a sine wave. This is the reason for the band-pass filter consisting of L7, C32, C34 and R57. Since it is the sum signal which is desired out of Balanced Modulator 2, it is followed by FL3, a high-pass filter.

APC

The other input to balanced modulator 2 is the 3.58MHz signal developed in IC5, the APC circuit.
The APC circuits lock-up to the incoming color burst signal. The color signal is gated so that only the burst is passed, and the 3.58MHz signal generated by IC5 is compared against the burst so that phase-lock can be obtained.
The color burst signal, or reference signal, is obtained through Q10.
The collector circuit is 3.58MHz resonant and contains diodes D8, 9 as limiters.
The burst signal out of Q10's collector is applied to pin (6) of IC5, one input to the APC phase comparator.
The other half of the APC circuit is the 3.58MHz VXO inside of IC5. It produces a continuous wave 3.58MHz signal, governed by X2 and the control voltage applied to this crystal from the IC.
The output, from pin (14) is passed to the anode of D7. In the record mode, D7 if forward biased, and the 3.58MHz signal is applied to the base of Q12.
In the record mode, R12 is turned ON, and as will be shown later, Q11 is OFF.
Since Q12 is ON, it passes the 3.58MHz signal to its emitter circuit. The voltage across L9 is fed back into IC5 through pin (3).
In the comparator stage, any difference between the reference and generated 3.58MHz signals will be measured, and an error voltage will be produced to drive the VXO is the necessary direction so that there is no difference.
The output 3.58MHz signal at pin (14) is a continuous going sine wave of the same phase as the incoming burst, and will be used in balanced modulator 2.

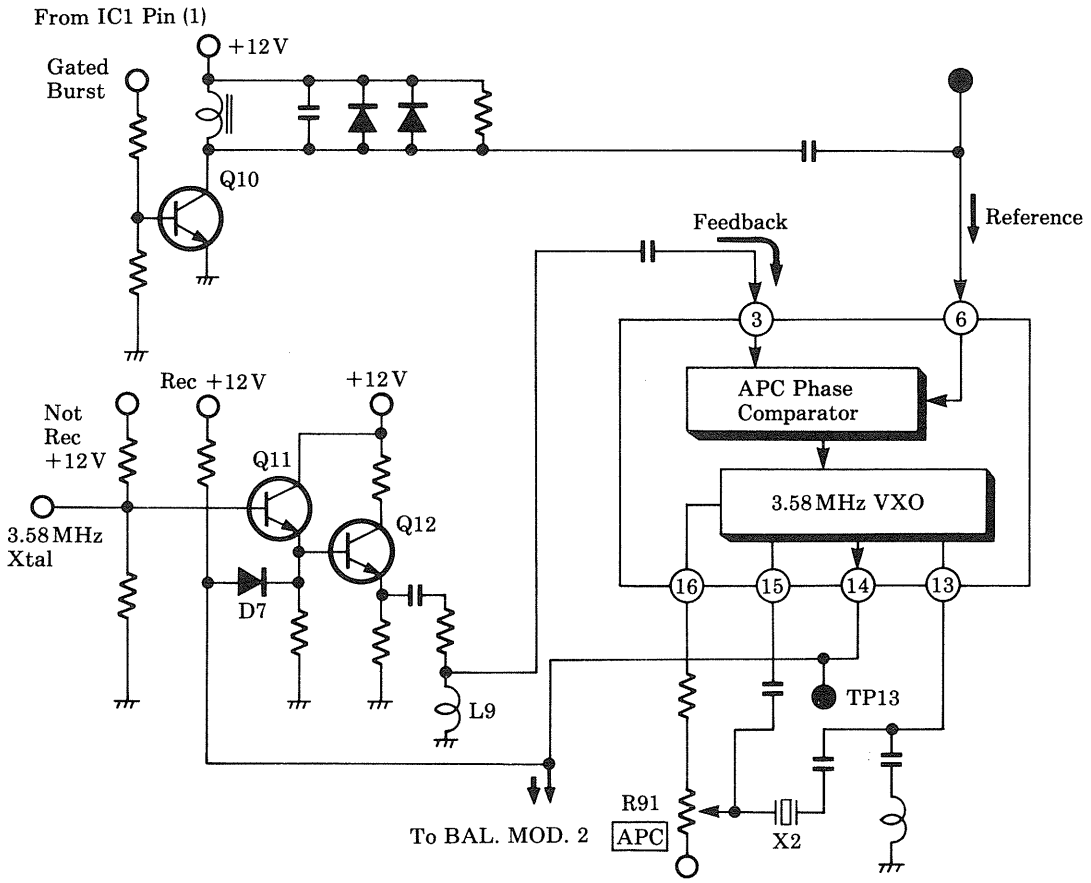



Fig. 117

Color Killer

The color killer circuit inside of IC5 detects the presence of burst and the accuracy at which the APC circuit follows the burst.
If there is no burst signal, the killer detector will not allow an ACK +9V signal to be generated. Likewise, if there is an APC failure, and the APC-generated 3.58MHz signal does not follow burst, no ACK voltage will be generated.
The killer phase detector is internal to IC5. One of its inputs at pin (6) is the incoming burst signal taken from the collector of Q10. This is the same connection as was used for APC, Fig.117. The killer phase detector works in a similar fashion as the APC phase componator. Phase comparison is made between the input at pin (6) and the input at pin (4).
The input at pin (4) in the recording mode comes from the collector of Q12.
In the record mode, then, the signal at the collector of Q12 is the phase inverted 3.58MHz VXO signal, which originally came from pin (14) of IC5.
The killer phase detector measures the phase difference between incoming burst and the 3.58MHz VCO. If a great phase difference exists, for instance if the APC circuits failed or if there is no color signal input (B/W signal) the detector will produce a low signal at pin (7), which is normally high.
If a phase difference of exactly 180° is present a low signal appears at pin (8). This 180° phase detection will be covered in the playback section.

ACK

The killer phase detector will determine if there is no incoming burst, or if APC action has failed by supplying a low signal at pin (7) of IC5. This low signal is used to turn off the color circuits.
ACK switching is performed as follows:

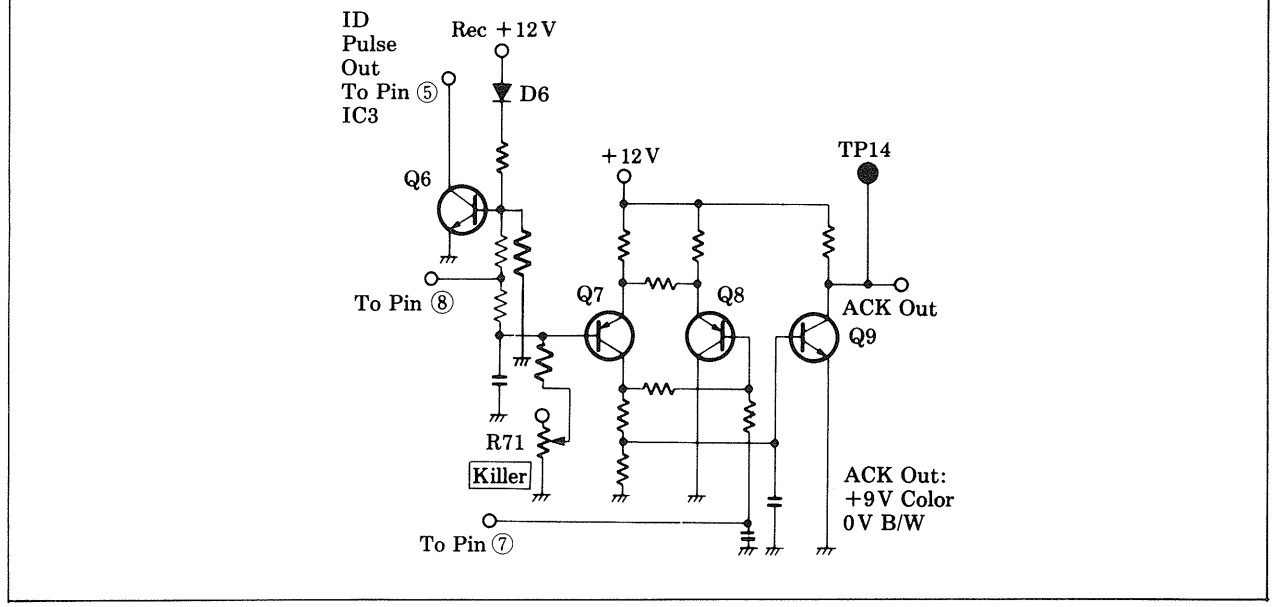



Fig. 118

When recording a color signal, which is referred to as the normal condition, when the APC-AFC operations are functioning properly, the killer phase detector will measure a very good match between the incoming burst and the internally generated 3.58MHz VXO signal, and produce a high signal at pin (7) of IC5. This is applied to Q7, 8, 9 to produce an ACK +9V signal at TP14.

## CHROMINANCE PLAYBACK PROCESS

### *General Description*

The simplified block diagram for the Chrominance Playback Process is shown below.

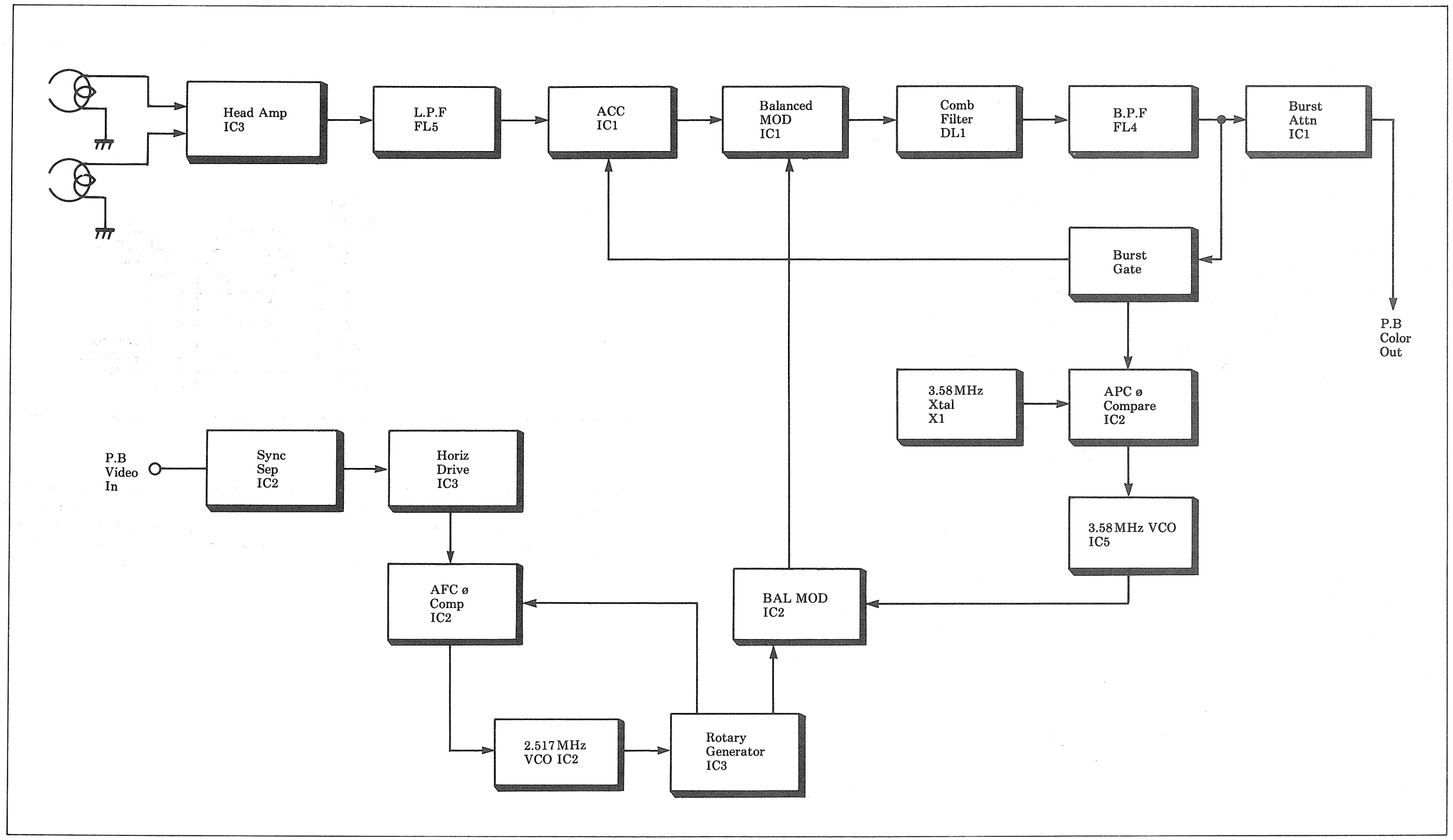



Fig. 119

ACC

Similar to the recording process, ACC is used during playback to keep the overall level of the chroma signal constant. The ACC circuit looks for a change in playback burst amplitude, and adjusts its gain accordingly.

BALANCED MODULATOR I

One input to the balanced modulator is the playback 629kHz rotation chroma signal. The other input, is still a 4.2MHz phase-locked rotational signal, as was used in the record mode, except that it is phase-locked to the playback signal itself. These two signals are inputs to the balanced modulator, and the output, again selected to be the difference, is a 3.58MHz chroma signal with no rotation and no instability.

BURST ATTENUATION

In the Record mode, the burst signal was boosted for an improved S/N ratio. The reverse action, burst attenuation, must be performed in Playback.

3.58MHz BAND PASS FILTER

A bandpass filter is used to eliminate any residual energy above or below the desired chroma bandpass. Only information centered at 3.58MHz ±approx. 0.5MHz is allowed to pass as bonafide chroma information.

COMB FILTER

The comb filter is used to eliminate chroma crosstalk.
Using vectors, the chroma phase can be shown as it is put on the tape. For Field A or, the track recorded by Head A, the phase of the color signal is advanced by 90° every horizontal line. Conversely, the phase is delayed by 90° every horizontal line. On the tape:

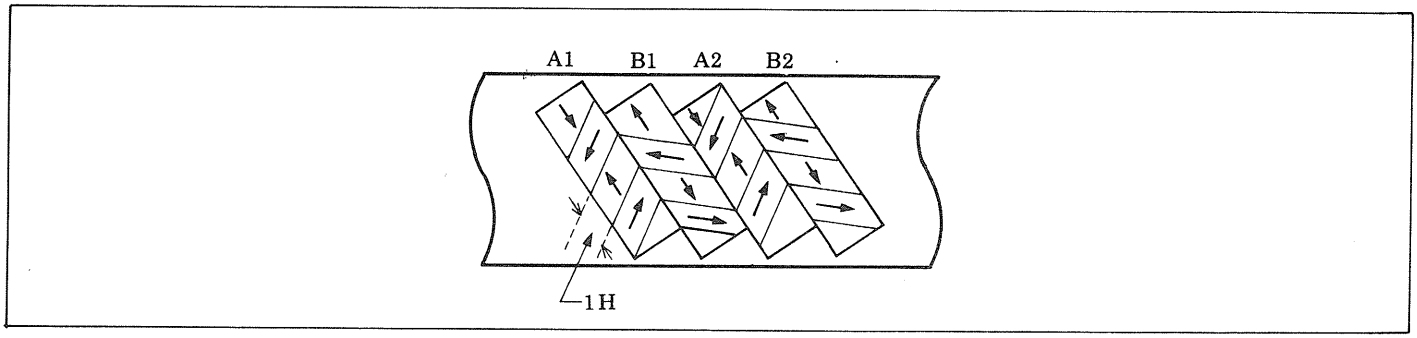



Fig. 120

No matter whcih head (A or B) is used as an example for playback, it will pick up information from the adjacent track. The vectorial representation of this playback signal is also shown:

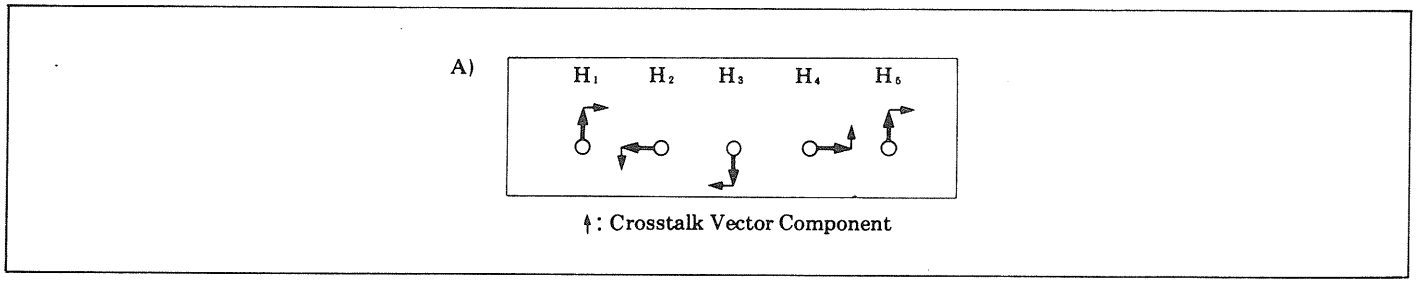



Fig. 121

Notice that the small vectors which represent crosstalk are always at 90° from the desired signal.
In playback, the main vectors are rotated to their original 0° phase, and of course, the crosstalk vectors rotate with them.
The phase-restored signal has a crosstalk component which between any two adjacent lines is 180° out of phase. With this in mind, the comb filter can be built.

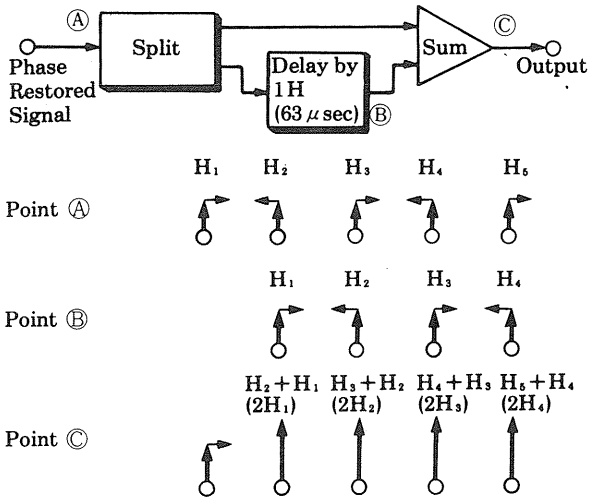



Fig. 122

The action of splitting the phase restored signal, delaying one path and then adding the two paths together again is basic comb filter action.
Adding the 1H delayed signal to the undelayed signal places the crosstalk vectors out of phase and they cancel. The desired chroma information, on the other hand, is doubled in amplitude.
Bear in mind that the comb filter works on the premise that the chroma information, and therefore chroma crosstalk, between any two lines in a field is nearly identical, but it is not absolutely identical.
The comb filter adds crosstalk from Line 1 to Line 2, and from Line 2 to Line 3 and so on. The crosstalk signals of Lines 1-2, or 2-3 are almost the same, so they cancel to a near perfect zero-not absolute zero.
And, the double amplitude chroma signal itself, is not a perfect double amplitude signal-it is nearly perfectly doubled, with some distortion which represents what the difference between adjacent lines really is. But since the difference is very, very small, the residual crosstalk and distortion is certainly allowable and is not detectable on the screen. Indeed, if the comb filter were not used, the crosstalk, as seen on the screen, would be objectionable.

## COLOR KILLER

The killer is used again in playback to block any output from the chrominance board in the B/W mode. If the color circuits were not "killed" in the B/W mode, noise from these circuits would mix with the B/W signal producing an overall noisy picture. In the color mode, the color circuits are of course allowed to pass their color information.

## BURST GATE PULSE GENERATOR

This is the same circuit that was used in recording except that it uses the playback horizontal sync to generate its pulse.

AFC-ROTARY PHASE

The AFC-Rotary Phase circuits perform the same function in the playback as they did in recording, namely to produce a phase-locked, rotational 629kHz signal.
The only difference is that the AFC circuits lock up to the playback signal itself, i.e., the playback horizontal sync.
So, in this case, the AFC locks up to the playback horizontal sync, and it drives IC3, the rotary generator. The rotary generator then produces a rotational signal in which the phase changes by 90° per every playback horizontal sync pulse.
The actual rotational process is the same as in the recording mode.

APC

The APC circuit in playback still produces a 3.58MHz signal to be used in Balanced Modulator 2, but it is not a steady 3.58MHz signal.
Its frequency is always fluctuating slightly about 3.58MHz.
This is necessary to produce a rock solid 3.58MHz signal out of Balanced Modulator 1, which will be covered later.

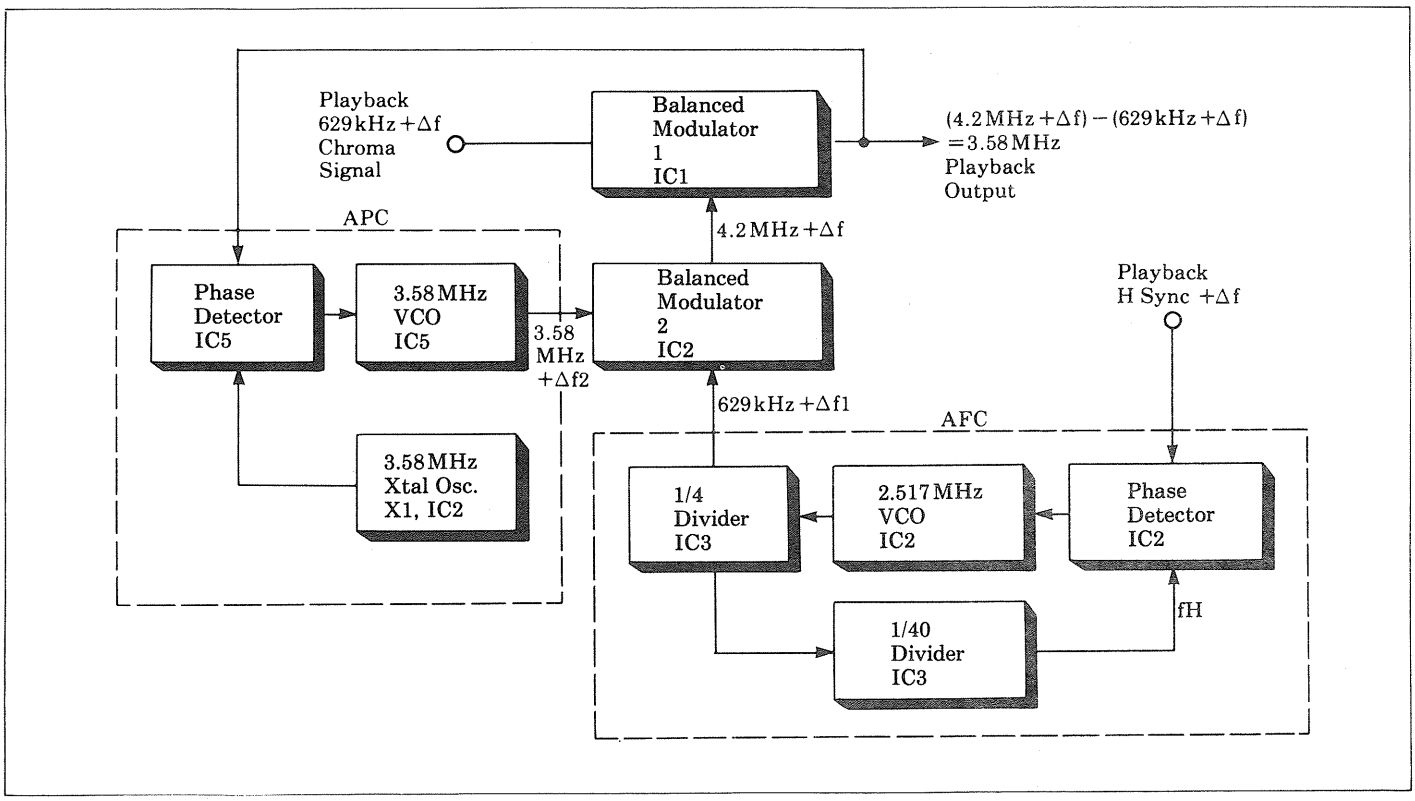



Fig. 123

BALANCED MODULATOR 2

Balanced Modulator 2 performs the same functions in playback as it did for recording. It supplies a phase-locked, rotational 4.2MHz output from its phase-locked rotational 629kHz input and its 3.58MHz C.W. input.
The only difference is that the 3.58MHz C.W. signal for playback is not rock solid or phase-locked signal--but rather a 3.58MHz plus or minus some small frequency change in order to drive the output of Balanced Modulator 2 towards the proper direction.
This is explained in the next sections.

DELTA FACTOR ($\Delta f$)

When any VTR plays back, it is subject to some degree of "wow and flutter". The proper video term to use is "jitter" or "instability". In other words, the VTR machine cannot physically move the tape and spin its video heads in EXACTLY the same fashion for playback as it did for recording. It comes close, but it is not perfect.

This is supported by the fact that the tape itself can change according to ambient conditions such as temperature and humidity. It can stretch, shrink, wrinkle, etc. These factors all contribute to playback jitter.

What playback jitter actually creates is a delta factor, $\Delta f$.

$\Delta f$ is "a change in frequency", and it means that the playback horizontal sync rate may not be exactly 15.734Hz but rather, at any instant, some small amount above or below it.

Similarly, the chroma signal in playback, is at any moment either 629kHz or some value slightly above or below it. This is where a problem lies. If the 629kHz+$\Delta f$ signal were balance modulted with a 4.2MHz signal, the difference would be 3.58MHz-$\Delta f$.

Notice that the $\Delta f$ still appears in the output. The problem is that most TV receivers will not lock up to a 3.58MHz-$\Delta f$ signal-it must be exactly 3.58MHz. The TV set either shows poor or no color.

Conversely, the TV receiver is able to use 15.734kHz+$\Delta f$, because the more tolerant horizontal circuits in the TV will still produce good pictures.

This is why the playback chroma signal must have jitter correction and the playback luminance signal does not.

The playback AFC/APC simplified diagram will help explain:

The object is to produce a rock solid 3.58MHz chroma signal out of the chrominance board. Looking at the AFC section, it can be seen that the AFC network locks up to the playback horizontal sycn.

Remember that the playback sync and playback chroma signal have a $\Delta f$ component.

When the AFC locks to the 15.734+$\Delta f$ signals, it produces a 2.517MHz+(160$\Delta f$) signal (because of multiplication by 160).

Then, it is rotated and down converted to a 629kHz+(40$\Delta f$) rotational signal. Now, the jitter component, although changing by small amounts, can change very rapidly. The truth is that the AFC may not accurately follow all of the jitter, so that the rotation signal may be 629kHz+$\Delta f_1$.

Where $\Delta f_1$=(40 some small amount)$\Delta f$.

Yes, the AFC may itself inaccurately follow the playback $\Delta f$ to produce its own $\Delta f_1$, component! This is a fact in ALL VTR's!

This is compensated by the APC loop. Look at the APC loop. The VXO is driven by a phase comparator which is comparing the actual playback chroma frequency to a stable 3.58MHz source, a crystal. What the APC loop will do is to sense a change in the chroma output away from 3.58MHz and then drive the VXO in the necessary direction to compensate. For example, assume that the AFC is producing a 629kHz+$\Delta f_1$ rotational signal and the APC is producing a 3.58MHz signal.

Balanced Modulator 2 will accordingly produce a sum signal, or 4.2MHz+$\Delta f_1$ rotational signal, to be sent to Balanced Modulator 1.

The playback 629kHz+$\Delta f$ rotation signal and the 4.2MHz+$\Delta f_1$ rotational signal now enter Balanced Modulator 1, which produces a difference signal, or:

$(4.2\text{MHz}+\Delta f_1)-(629\text{kHz}+\Delta f)=3.58\text{MHz}+\Delta f_1-\Delta f$

Clearly, this is not good enough.

But, if $\Delta f_1$+(some other frequency) equalled $\Delta f$, the delta factor would be cancelled.

What is needed is a new $\Delta$ frequency, $\Delta f_2$ which when added to $\Delta f_1$ would equal $\Delta f$.

This exactly what the APC loop does.

The APC loop will develop a new Δ frequency as necessary to produce a solid 3.58MHz output.
The APC phase detector drives the VXO so that is produces:
$3.58MHz+\Delta f_2$
where $\Delta f_2=\Delta f-\Delta f_1$. $\Delta f_2$ makes up for the inaccuracies of the AFC loop. Again, balanced modulators add or subtract frequencies, as well as any characteristics of it input frequencies such as Δf's or phase shifts.
Balanced Modulator 2 is followed by a high pass filter so that only the sum signal passes.
Balanced Modulator 1 is followed by a 3.58MHz BPF to select just the difference signal in the playback mode.
A lot of operations occur at the same time inside of Balanced Modulator 1:
1) Jitter Correction (Δf-Δf=0).
2) Rotation Correction (Rotation-Rotation=0).
3) Up Conversion (4.2MHz-629kHz=3.58MHz).
The exact same IC's and circuits are used for AFC/APC playback as were used for recording.
Playback seems much more complex, but it really isn't all that difficult. In the record mode, there was no Δf to worry about, and if there was, the system would handle it.
Balanced Modulator 2 is always producing a 4.2MHz Rotational signal, its just that in playback, Δf is involved.
Balanced Modulator 1 is always subtracting something from the 4.2MHz rotational signal.

In record: (4.2MHz+Rotational-(3.58MHz)
=629kHz+Rotational

In playback: (4.2MHz+Δf+Rotational)-(629kHz+Δf
+Rotational)=3.58MHz

Once the reasons for the processes are understood, the processes themselves seem much simplier.

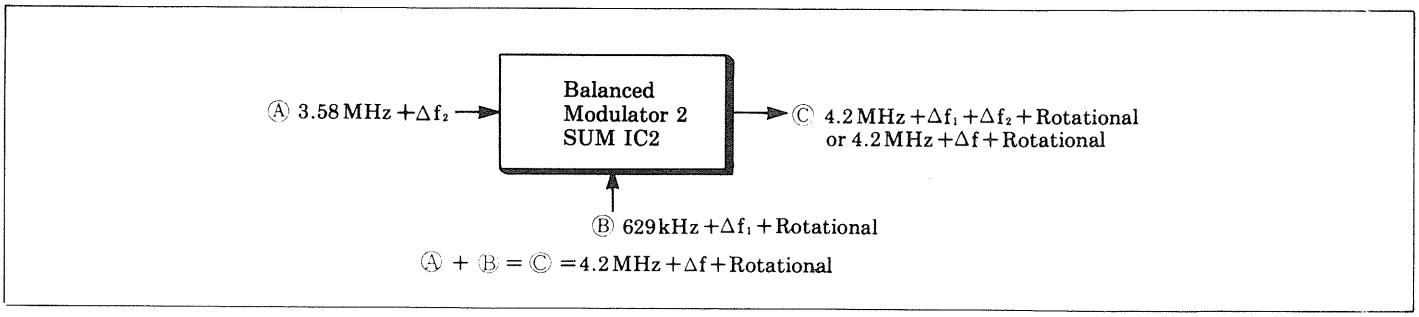

Ⓐ 3.58 MHz +Δf₂
Balanced
Modulator 2
SUM IC2
Ⓒ 4.2 MHz +Δf₁ +Δf₂ +Rotational
or 4.2 MHz +Δf +Rotational
Ⓑ 629kHz +Δf₁ +Rotational
Ⓐ + Ⓑ = Ⓒ =4.2 MHz +Δf +Rotational

**Fig. 124 Balanced Modulator 2**

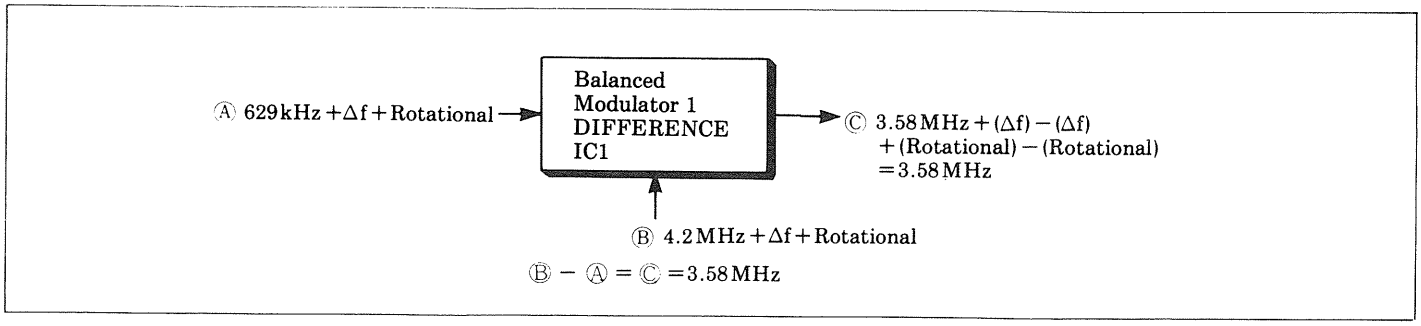



**Fig. 125 Balanced Modulator 1**

ACC

In order to maintain an overall constant color level, playback ACC is used. The same circuit is used for the playback mode, as was used in recording. The main difference is that for playback, the ACC controls the gain of the 629kHz signal by looking at the level of the final playback 3.58MHz burst signal. In other words, if the final playback color signal has a changing burst level, it will be detected and used to control the gain of the 629kHz signal coming into the chrominance board, P82-10, in order to compensate for the change.

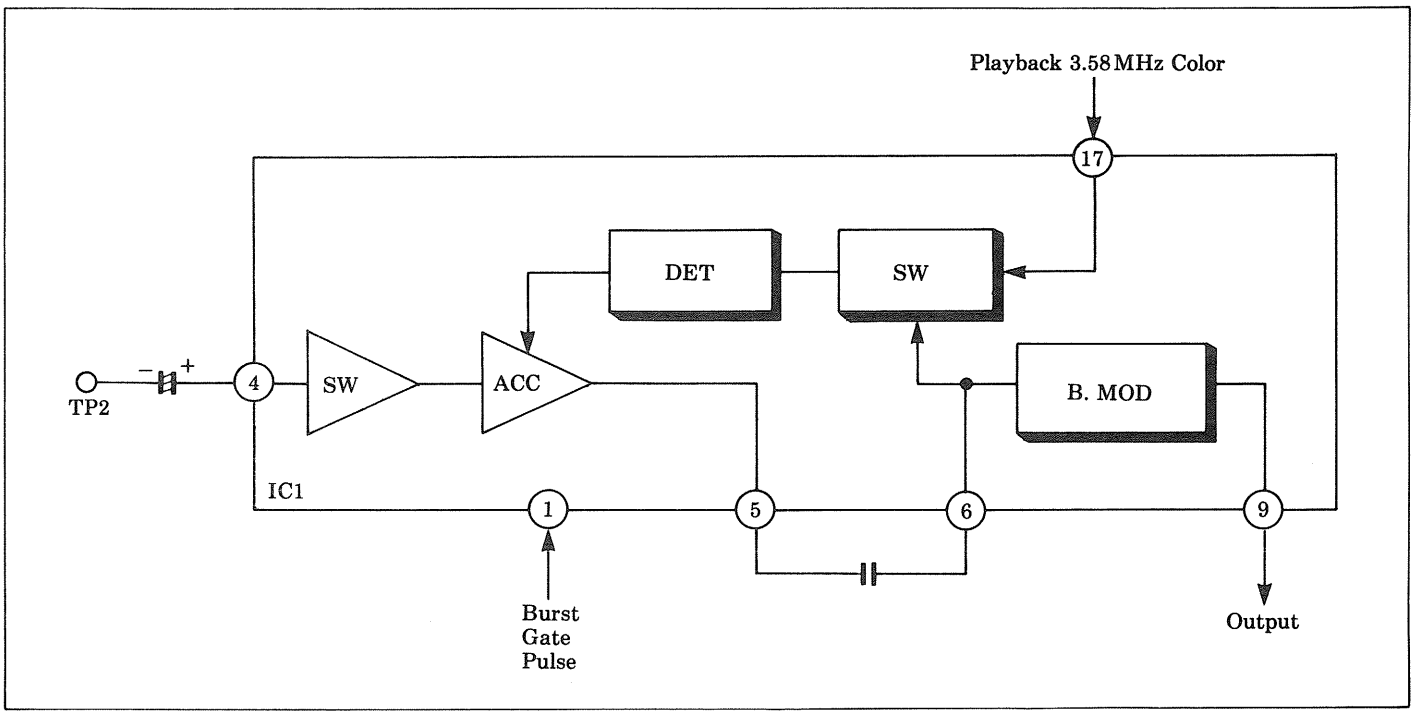



Fig. 126

The input to the ACC circuit inside of IC1 appears at TP2 and pin (4). The burst gate pulse into pin (14), functions the same as in the record mode. The final 3.58MHz color signal is then passed to pin (17) and will be used in the burst gate section.

Balanced Modulator 1

Inside of IC1, Balanced Modulator 1 will convert the 629kHz rotational unstable color signal off the tape to a 3.58MHz non-rotating stable signal. As was explained in the general section, the two inputs to the modulator are the 629kHz signal, and a 4.2MHz signal which has the same instability and rotation as the 629kHz signal. When 629kHz is subtracted from 4.2MHz, the result is 3.58MHz. And as was shown before, the rotation and factor are cancelled. The Balanced Modulator 1 circuit is nearly the same in playback as it was for record, except that the output path is different.

The output IC1 at pin (9) is then sent to comb filter. Development of the 4.2 MHz signal will be covered later.

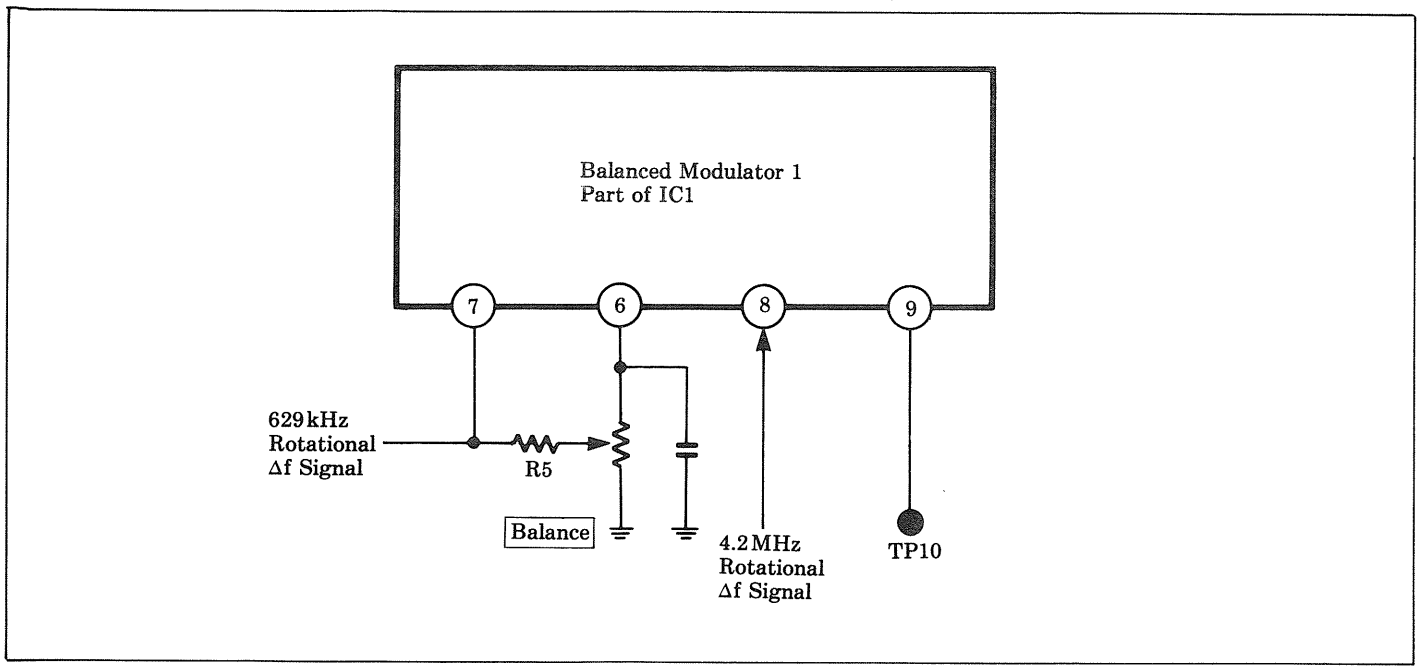



Fig. 127

Comb Filter

In order to greatly reduce the color crosstalk signals which can occur during playback, a comb filter is used. The principle of the comb filter as was already explained, is to add together a delayed and underlayed color signal which doubles the desired color signal and eliminates the crosstalk.

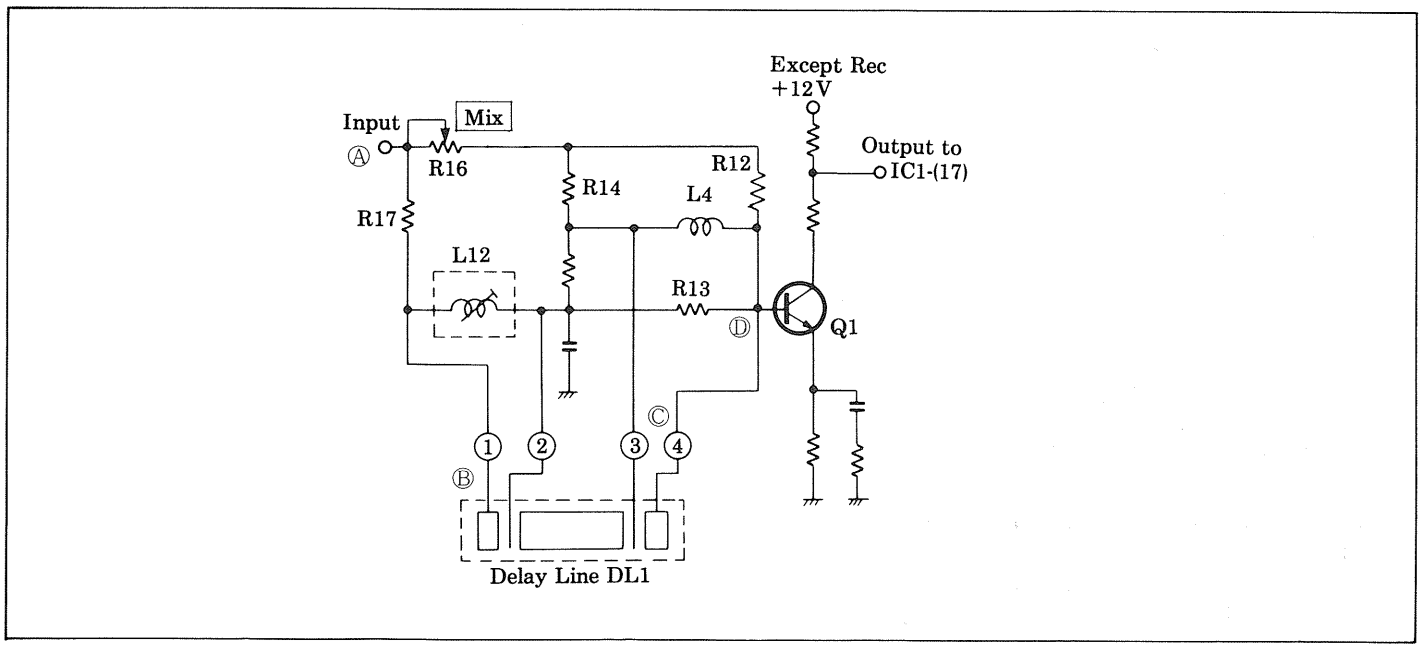



Fig. 128

The input signal is split into two main paths. The delayed path is through R17, and the delay line, to the base of Q1. The underlayed path, whose level is adjustable by R16, MIX, is through R12, then to the base of Q1. It is evident that the two signals will add at the base of Q1.
Let's re-examine the function by waveforms:

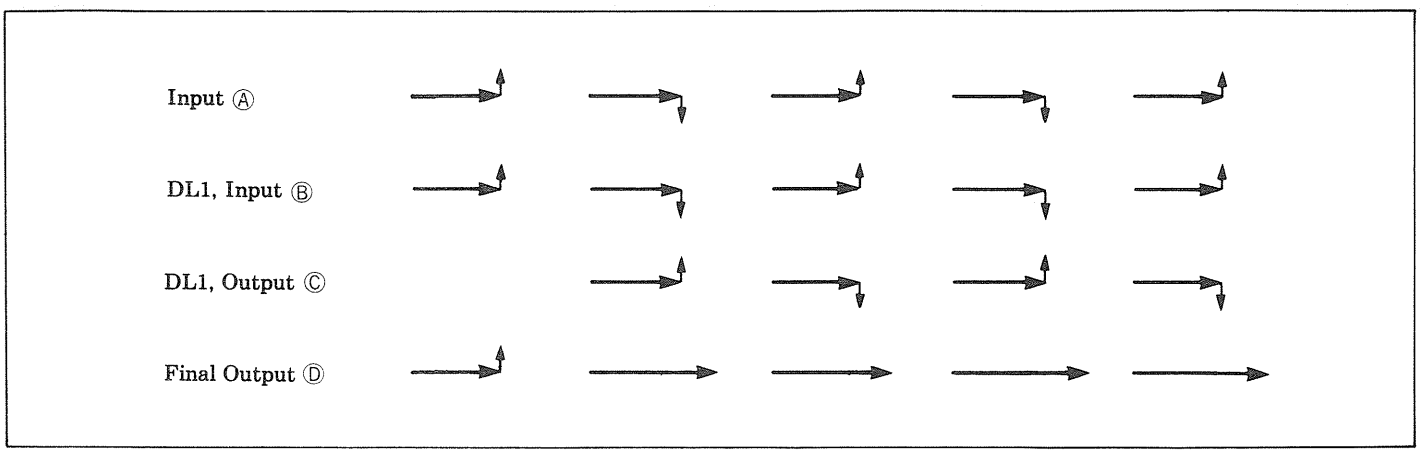



Fig. 129

The input to the circuit A and the input to the delay line B are the same signal and can be represented by vectors.
The large vectors pointing to the right are the main color signals.
While the small vectors pointing up and down are representing crosstalk.
The delayed signal, waveform C is then added to A to produce waveform D -- a double amplitude color signal with no crosstalk (except for the very first and very last lines of a field).
The mix control, R16 is adjusted so that waveforms A and C are of equal amplitude. If they were not equal amplitude, there would be some residual crosstalk.
Transformer L12 is used for fine phase adjustment in the delay line input and output circuit. The effect on the comb filter operation is not significant as seen in the final playback picture--so it is best left at the factory-set positions.
The crosstalk-free signal is amplified by Q1, the output of Q1 is routed to B.P.F.FL4 and is used in the ACC circuit for playback.

Burst Gate

The burst gate section performs the same job in playback as it did for recording, except that it uses the playback signal.
Notice that input to the sync separator is still through P81-10.
In the playback mode, the playback signal appears here.
The only function of this circuit that is different from the recording mode is the dropout inhibit pulse. This pulse comes from IC2 - 5 in the dropout compensator circuitly. When a dropout occurs, this low-going pulse will prohibit an output from appearing at pins (14) and (15) of IC3.
This action will do two things: 1) a burst gate pulse will not be generated during the dropout, 2) the feedback path to the AFC circuit will be broken [no signal at pin (14)].
This is desirable because during a dropout we know that the unit is switching from a bad signal to the last good signal.
This transition could upset both the AFC and APC circuits, and cause them to overreact, which would require a considerable recovery time. Instead, if the AGC/APC circuits were just kept where they were, and not allowed to react to the transition, the operation would be a lot smoother. This is the purpose of the dropout inhibit circuit.

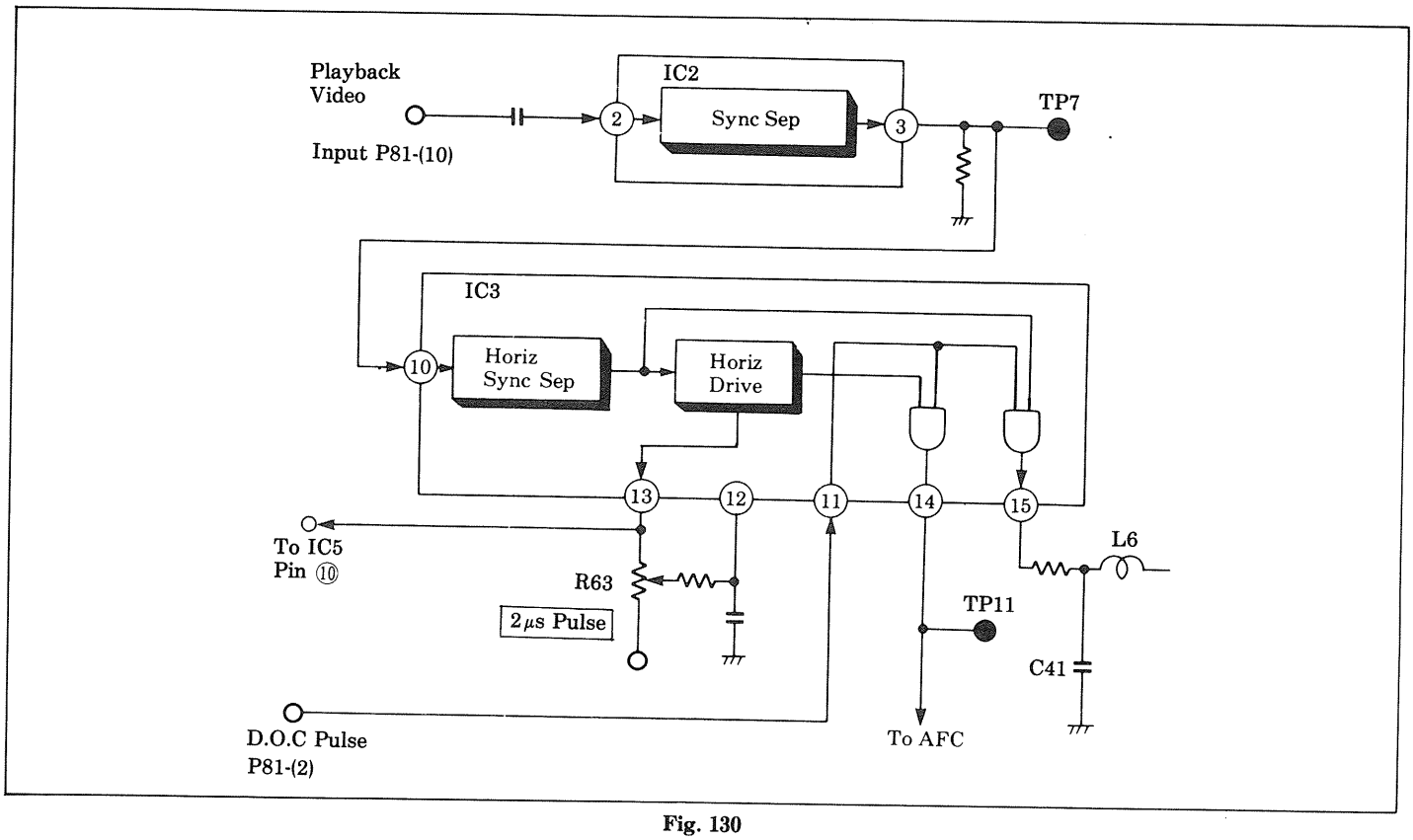



Fig. 130

AFC - Rotary Phase

The AFC functions identically the same for both the recording and playback modes. The rotational operation of IC3 as described for the recording mode fully applies to the playback mode.
IC3, the rotary phase generator, and IC2, AFC, function together as a closed loop, again as in the recording mode. Fig.131 shows this.

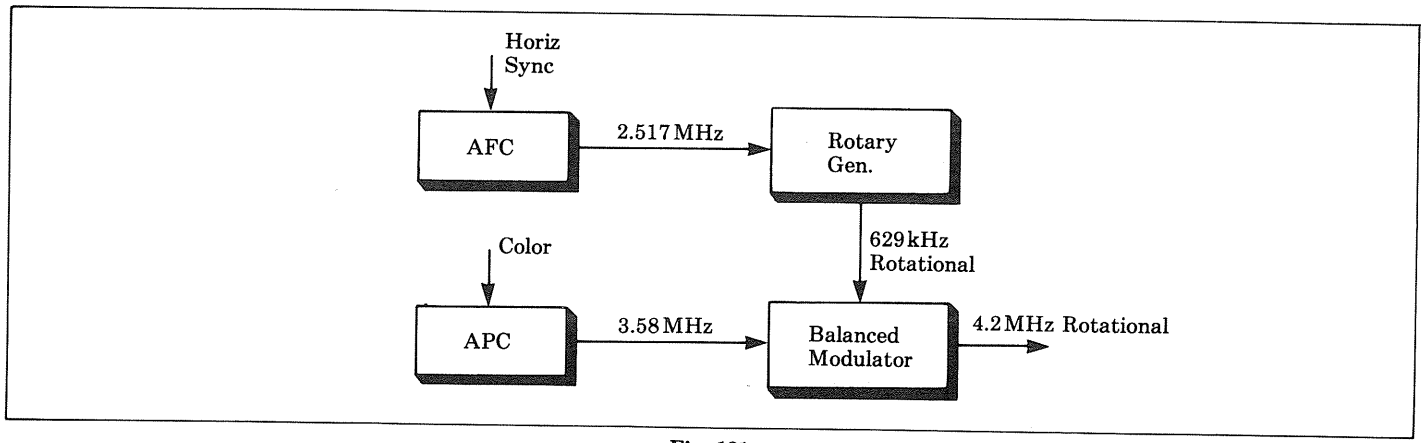



Fig. 131

The playback difference is the HD signal entering on pin (IC2). It is derived from the playback signal itself, sync separated, etc.
The $F_H$ signal, at pin (7), is from IC3, to form the closed loop. The one important thing to remember here is that the AFC action will cause IC2 and IC3 to lock to each other and to the $f_H$ signal. Therefore, any $\Delta f$ present in the $f_H$ signal will be carried through and be present in the 630kHz rotational output of IC3.

APC

The APC circuits will use the actual playback color signal for HS playback operation. This is fed into pin (6) of IC5, as shown in Fig.132.

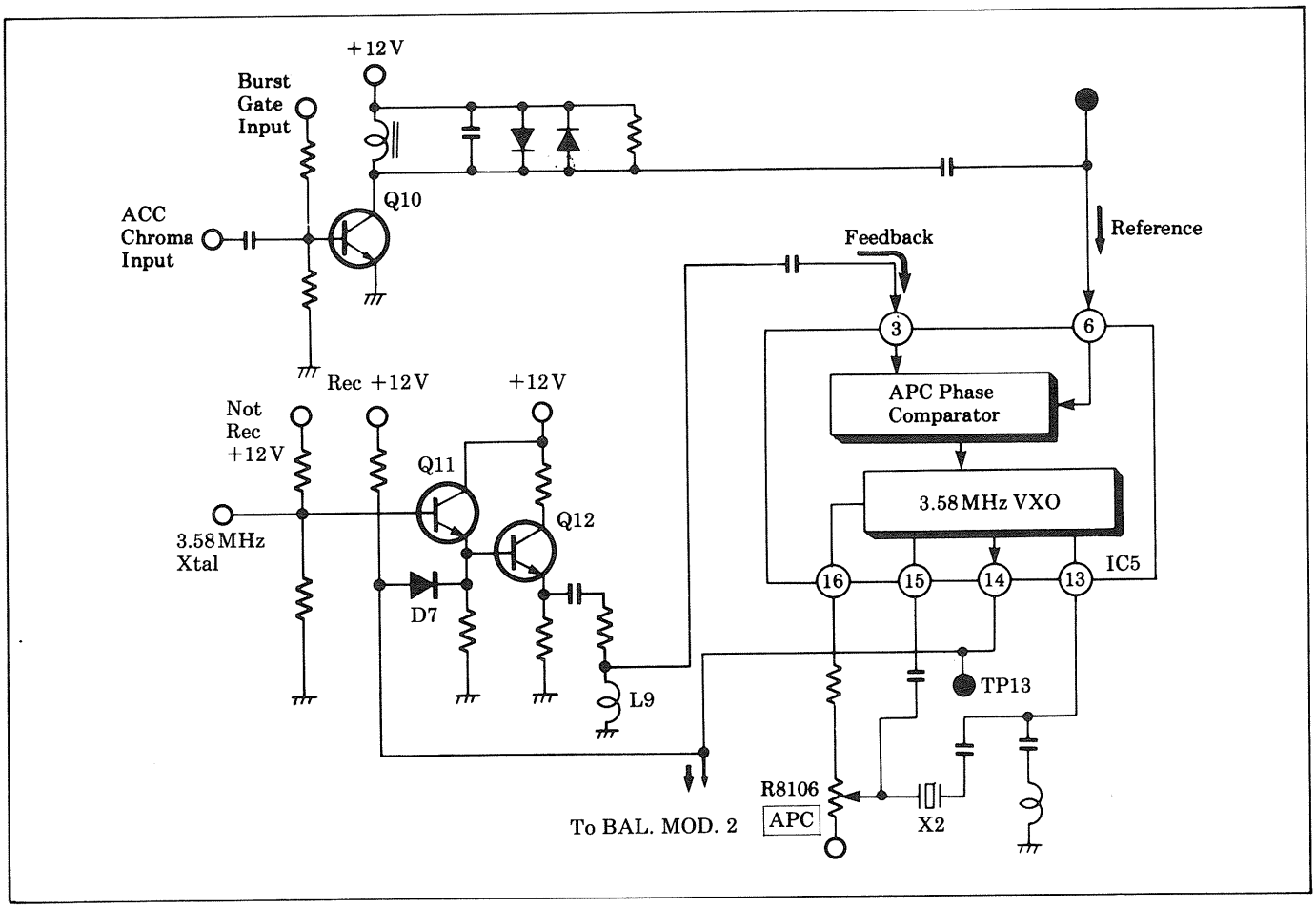



Fig. 132 APC

This playback color signal is compared against X1, a 3.58MHz crystal oscillator contained in IC2.
In the playback mode, differential switch, Q11, 12 switches to Q11 because of the lack of +12V applied to the base of Q12. Therefore, the signal at the base of Q12 will be used by IC5 as the reference. This signal is the 3.58MHz signal from X1, as just mentioned.
The APC comparator will develop an error voltage according to any difference between the reference and the playback color signal. This error voltage will drive the 3.58MHz VXO inside of IC5 in the necessary direction so that the difference can be eliminated back in Balanced Modulator 1.
As can be seen, the overall APC circuit functions identically the same for both the recording and playback modes. However, there is a process that is used in playback that was not described in the record mode. This is the action of burst inhibit. In playback, the video heads are constant by being switched ON and OFF. At the point where one head turns ON and the other turns OFF, there is a good possibility of tension or skew error. Remember this is a inherent characteristic of all helical VTR's.

The time base shift or instability encountered at this point can be large enough to momentarily upset the APC circuit--cause it to over-react, etc. In this instance, it might take a considerable length of time for the APC to recover. To prevent this from ever happening, the burst gate is turned off, so that it does not pass any burst signals for about 8 to 9 horizontal lines after head switching.

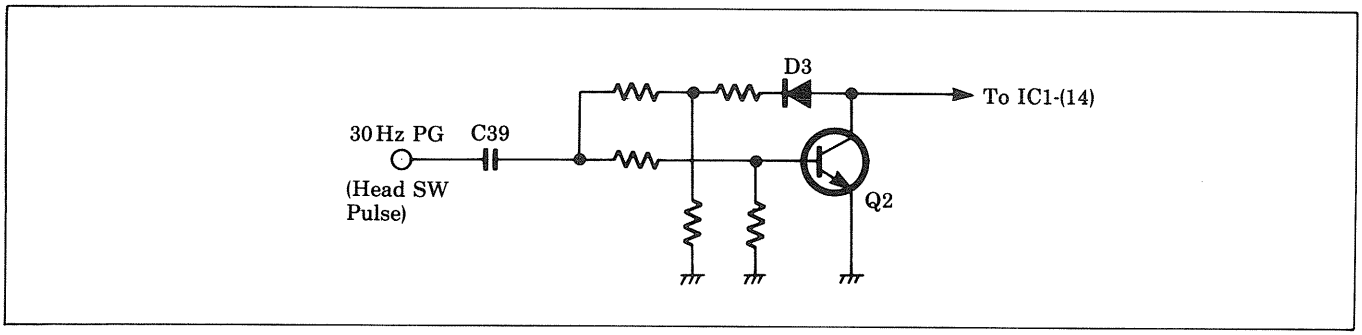



Fig. 133

The head switching pulse applied to Q2 is coupled through C39.
Assuming first that the head switching pulse is rising, it can be seen that through C39, the positive going differentiated pulse will turn ON Q2. When Q2 turns ON, its collector is grounded, inhibiting the burst gate.
When the head switching pulse goes negative, the negative going differentiated pulse through D3 will inhibit the burst gate.
Everytime the head switching pulse changes, either from high to low, or low to high, a gate inhibiting signal is produced.

Balanced Modulator 2

This modulator is still producing a 4.21MHz rotational signal.
Its inputs are the 630kHz rotational CW signal from IC3-5, and the 3.58MHz signal from IC5-14.
These two signals into the modulator have a total $\Delta f$ to be equal to that of the signal off the tape. The output is then a 4.21MHz rotational signal with $\Delta f$.

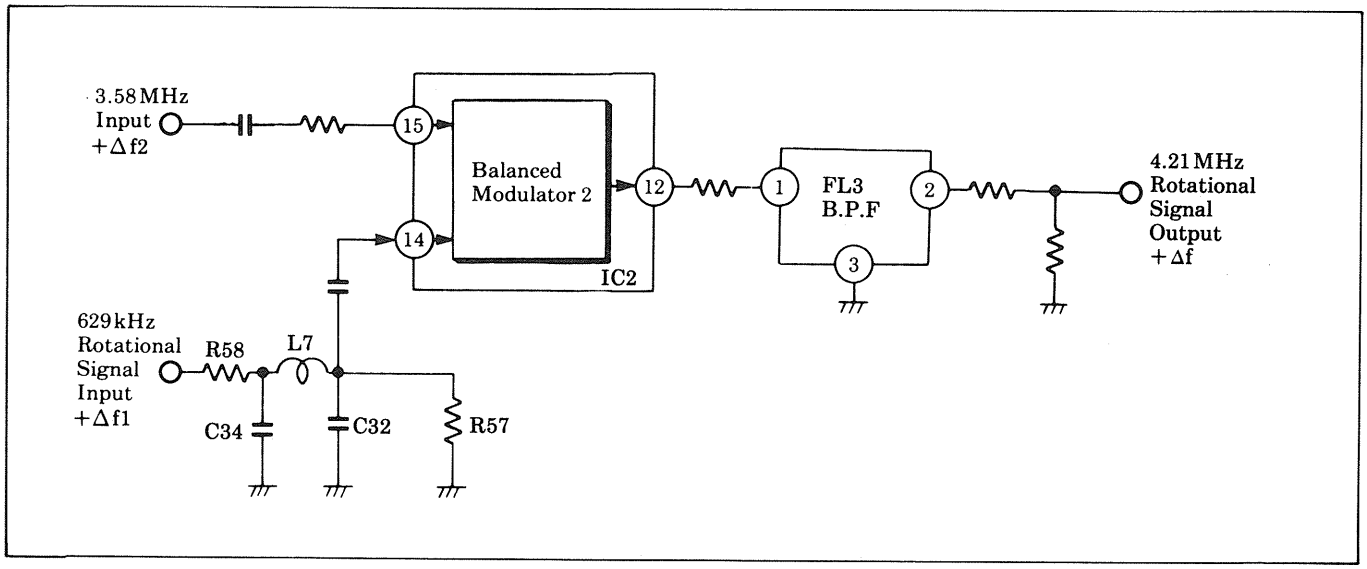



Fig. 134 Balanced Modulator 2

## AUDIO CIRCUIT

### General Description

The audio circuit is used for all audio amplification in recording and playback. It generates bias for recording (Ch1 and Ch2, and allows dubbing of audio over Channel (2). (Channel (2) only)

The audio circuit consists of two main sections, Ch1 and Ch2.

### Record Mode

In the record mode Ch2 can process one of two signals: either the signal from the microphone or the auxiliary (Line) signal.

Ch1 can utilize the audio signal selected by the input selector on the front panel (TV or Line) or the Ch1 microphone signal.

When microphones are used, they are connected through the microphone jacks on the front panel directly to preamplifier Q1 and Q13 to amplify the microphone signals (about-70dB) for Ch1 and Ch2 respectively.

If the auxiliary inputs are used (Line), the high level line signals are attenuated by voltage divider resistors in the microphone jack, and then applied to Q1 and Q13.

After amplification, the signals are applied to the audio level controls R601 (Ch2), R602 (Ch1). Also, after amplification, the signals are routed to respective tone amplifiers inside IC1 and IC2 which simply act as another stage of amplification through sw circuit Q3, Q16, respectively.

Finally, the audio signal for each channel is mixed with the bias signal and sent to the proper recording heads.

### Playback Mode

During playback the signals picked up by the Ch1 and Ch2 heads are sent to IC1 and IC2 through preamplifier Q4, Q5 and Q19, Q20, respectively.

Here the signals undergo playback equalization which boosts the low frequency signals and attenuates the higher frequencies. The outputs of the equalizer sections are amplified by several stages and connect to the headphone output, line and 8-pin output.

### Bias

A high frequency of 65KHZ for bias signal is also produced by the audio circuit board for the recording process. An astable multi-vibrator consisting of Q35, Q36 generates the 65KHZ signal.
This signal is transformer coupled to the audio circuit where it is mixed with the audio signals and applied to the audio heads.

Audio Dub

In the playback mode, it is possible to perform an audio dub over the Ch2 audio track. This process erases the previously recorded material on Ch2 track and places a new signal in its place.

The Ch1 audio track and video portions remain unchanged. Selecting the Audio Dub mode puts the audio Ch2 electronics into the record mode while keeping the Ch1 section in the playback mode.

Audio Dubs can be made on Ch2 only, using the microphone or auxiliary (Line) signals.

Playback Mode

In the playback mode the signal is picked up by the audio heads, H604-5(Ch1) and H604-4(Ch2) and supplied to the preamplifiers which consist of Q4, Q5, Q19 and Q20, respectively. Then, after preamplification, the signals are sent to the equalizer amplifier.

The playback signals are routed to pin (16) of IC1 and IC2.

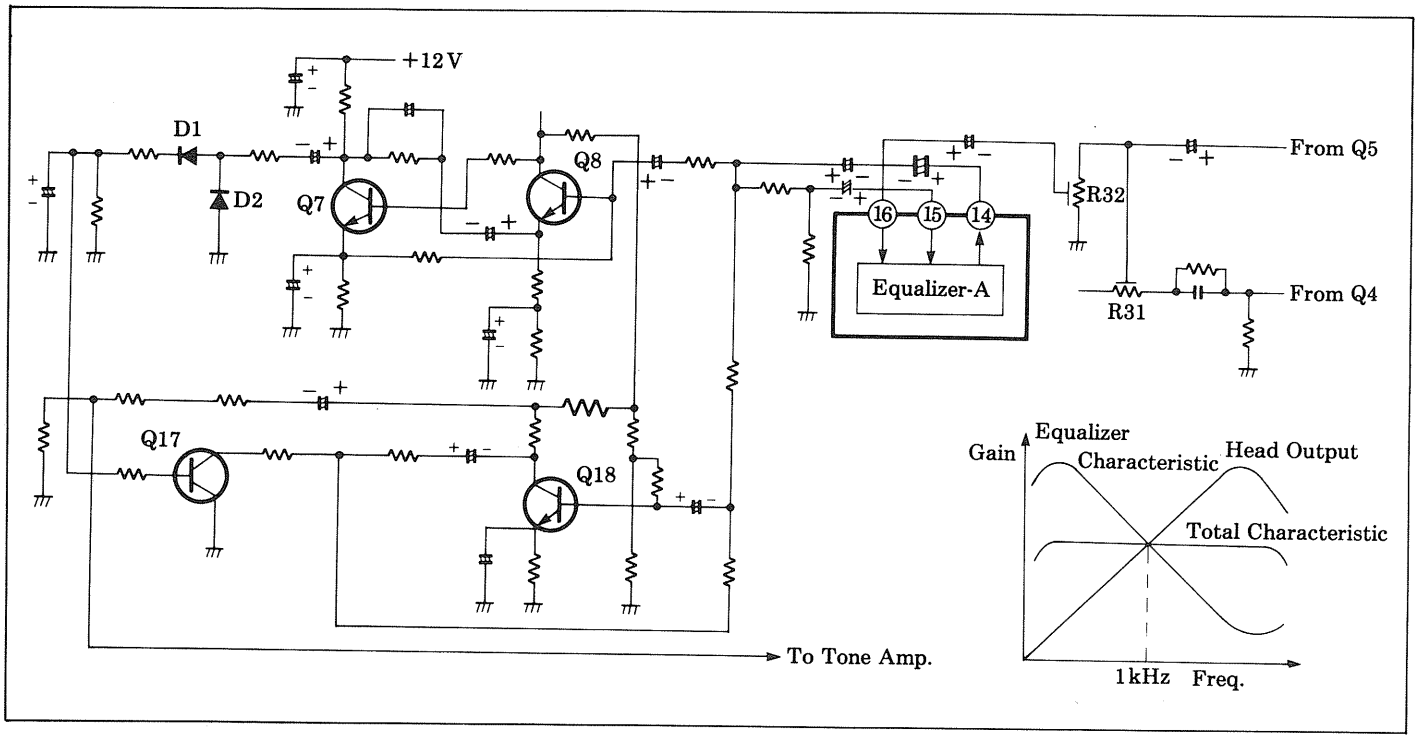



Fig. 135

See Fig.135. The purpose of the playback equalizer is to compensate audio frequency response against the audio head characteristics.

The purpose of boosting the higher frequencies during recording and attenuating during playback is to improve the overall S/N ratio, see Fig. 136.

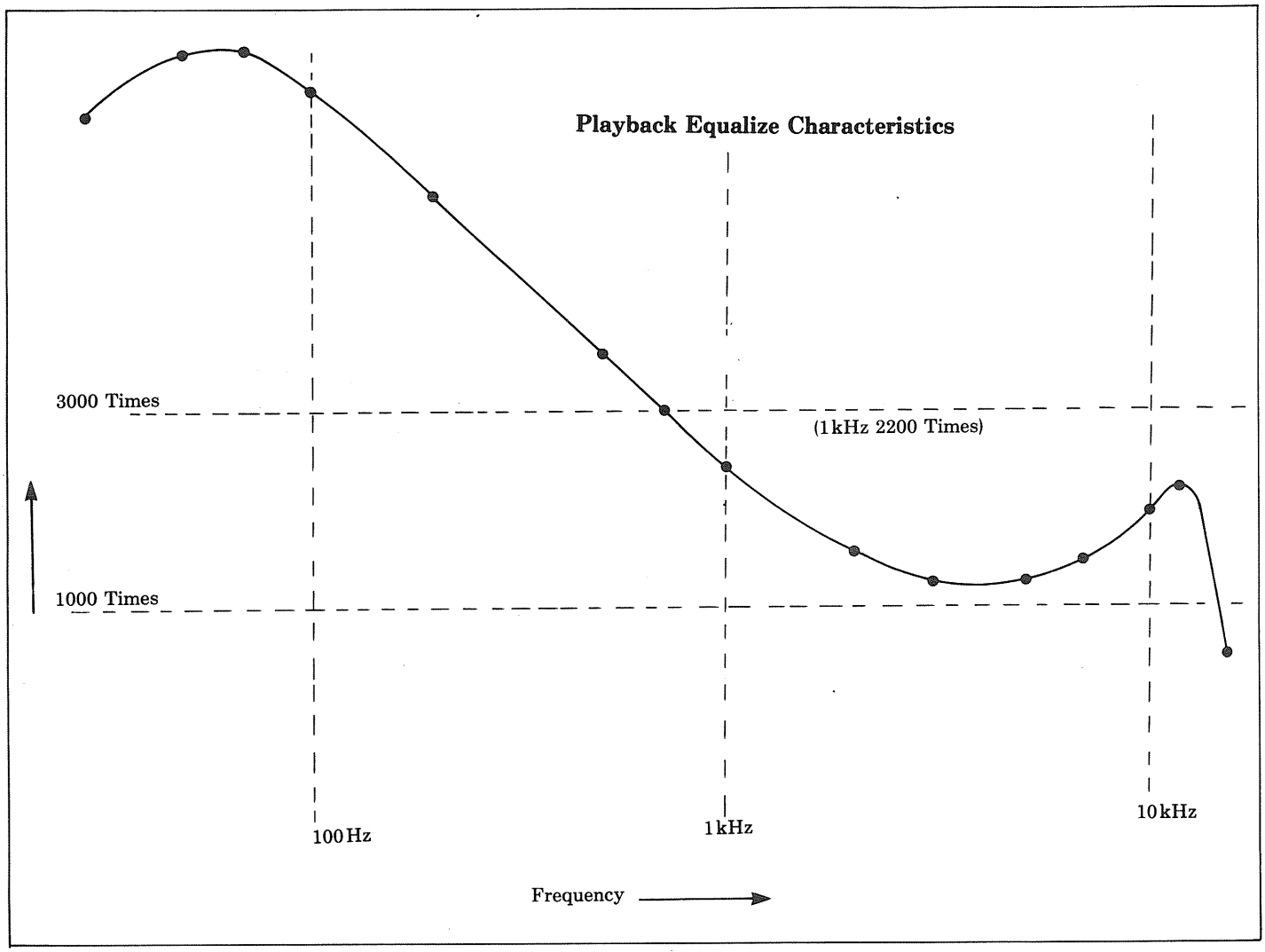



Fig. 136

The equalizer characteristic, determined by the frequency selective network of capacitors and resistors on pin 16 of IC1 and IC2, respectively, have the inverse shape of the playback head response.

The combined result is nearly a flat curve.

The frequency response of the playback equalizer is determined by R31 and R111, respectively. The playback gain of the equalizer is determined by R32 and R112, respectively.

The output of the equalizers are sent to TONE AMPs of IC1 and IC2. The amplified signal by TONE AMPs are again amplified by the LINE (OUTPUT) AMP of IC1 and IC2, respectively.

Then, the signals are applied to the audio output via Q10, Q11 and Q24, Q25, respectively.

Noise Reduction Circuit

The Noise Reduction Circuit is quite different compared with audio circuits of other VHS video tape recorders.

Signals from pin 14 of IC1 and IC2 are applied to Q7, Q8 and Q38, Q39, respectively, and amplified by approximately 60dB. After amplification, these signals are rectified by D1, D2 and D3, D8 for operating Q17 and Q40, respectively.

Q18 and Q33 reduce noise by half because the output of Q18 and Q33 is fed back to each input.

Record Mode

This description will apply to both Ch1 and Ch2 although diagrams will show components identified in Ch2.

In case of Line or TV input for Ch1, either Line or the TV signal is selected and applied to the MIC Jack.

If a microphone is used for the input, its low level must be amplified. The first stage amplifier, Q1, (Q13 for Ch2) is used for this purpose. This common emitter stage provides stable and clean amplification. The output of this first stage is sent to the level control resistors (R32 for Ch1, R112 for Ch2).

After this stage, the signal is sent to a transistor switch Q3 for Ch1, Q16 for Ch2.

In the record mode, these transistors are ON and pass the signals to their respective tone amplifiers of IC1 and IC2. This is simply an amplification stage between Pins 3 and 5.

The output at Pin (5) is then applied to another amplifier inside the IC to Pin 6. The output of this stage at Pin (10) is then sent to a distribution amplifier Q10, Q11 (Ch1) and Q24, Q25 (Ch2).
As can be seen from the diagram, Q11 (Q25 Ch2) supplies four outputs to the meter, 8P out, Line out and Head Phone out.

The input to Pin 7 of IC1 (IC2 Ch2) is the recording equalizer amplifier.

The purpose of the recording equalizer is to compensate for certain head and tape speed characteristics in order to improve the overall S/N ratio.
Since noise on the tape is largely contained in the higher frequencies, the S/N of the recording can be improved if the high frequencies of the audio signal are boosted. Upon playback, reduction of the high frequencies also reduces the noise.

The series resonant circuit consisting of C36 and L2 (C88 and L5 Ch2) at Pin 8 of IC1 (IC2 Ch2) increases the gain of this stage by 2dB at 10kHz by effectively creating a bypass. The overall amplitude VS frequency response of this stage is shown in Fig 137.

This equalized signal is mixed with the bias signal. The mixed audio and bias signals are then applied to the audio head, H604-5 (H604-4 Ch2).

Bias

In the record mode, a bias signal is necessary for proper recording. In the record mode (after loading is completed) +12V from Q34 is applied to the two primary center taps of T3.

This starts the astable operation of Q35-Q36. The frequency of oscillation is 65KHZ. Transformer T3 couples this signal to Ch1 Bias Adjust C77, Ch2 Bias Adjust C76, and to the center contact of relay K3 which connects with the Full Erase head. The bias adjustment allows for adjustment of the bias signal level applied to each head.

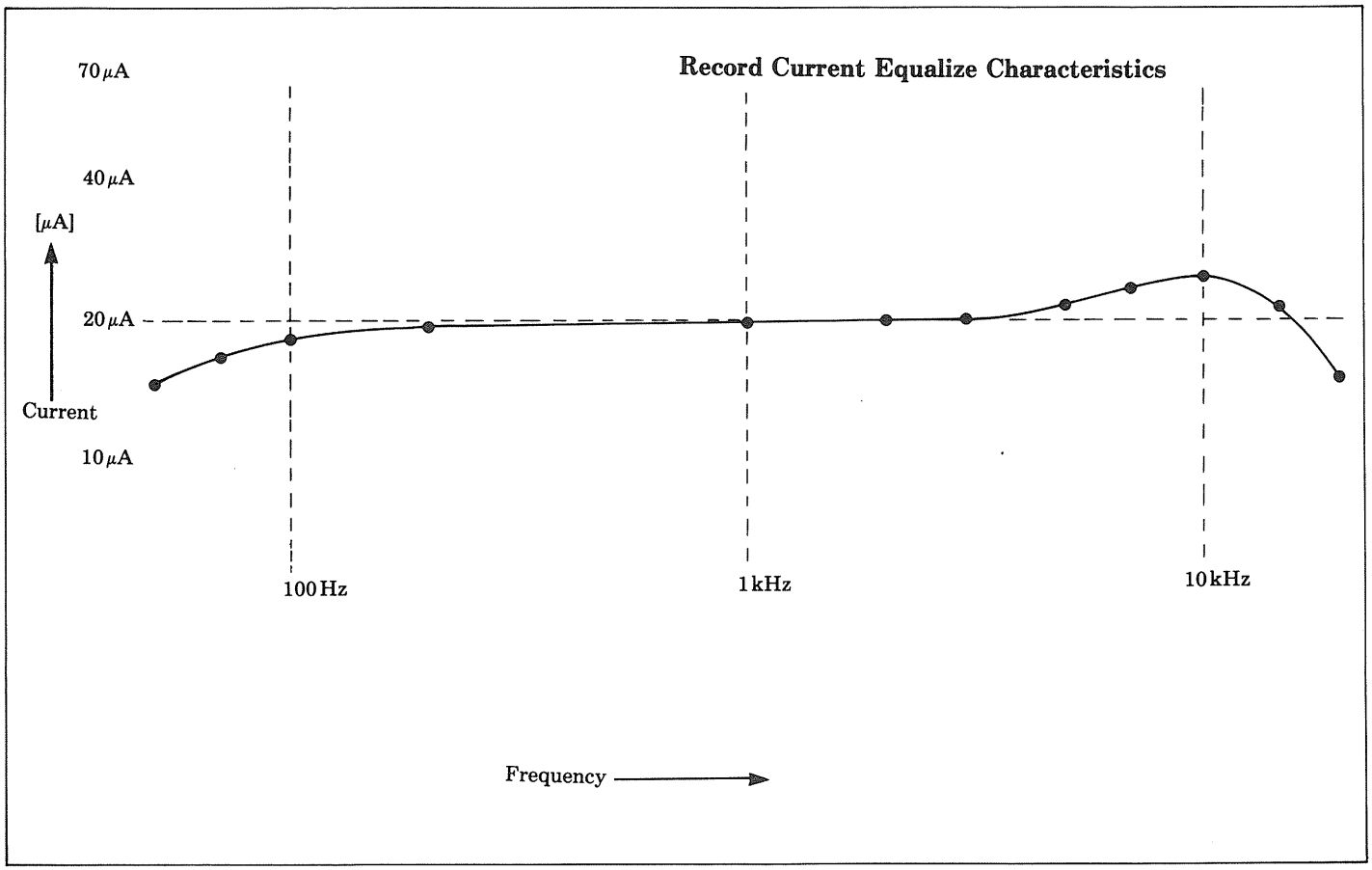



Fig. 137

## The Tape and Tape Format

The tape used in VHS is by itself a high quality product which assures good performance in a high density system.

The format of the tape is as shown below.

Tape Width (t): 1/2"

Tape Speed: 33.35mm/sec. (1.3 ips)

Head to Tape Speed: 5.8m/sec. (228 ips)

Video Track:

Width (w): 58μ (0.058mm)

Length (l): 96.8mm (3.8")

Angle (a): 5°58"

Audio Track:

Ch1 Width (1): 0.35mm

Ch2 Width (2): 0.35mm

Control Track:

Width (c): 0.75mm (0.03")

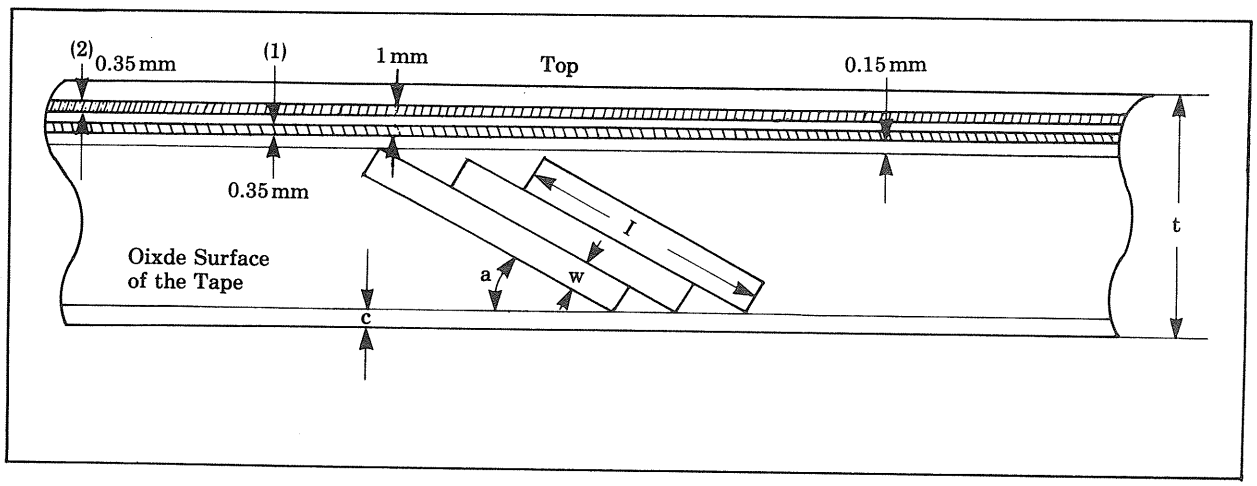



Fig. 138

## SEARCH CONTROLLER MODEL NV-A800

This unit is used to automatically locate a particular segment on the cassette tape when inserted into the NV-8200/8170 VTR. The search controller coordinates VTR mechanical modes (FF, REW, PLAY, PAUSE, STOP) in accordance with the manual keyboard entry (specifying a particular location of tape segment with respect to beginning of tape) and current CTL pulse count when a coincidence condition is detected the VTR is automatically placed into the PLAY mode displaying the desired tape segment on the monitor.
When the cassette is inserted into NV-8200/8170 and Power is turned ON the VTR will automatically go into the REW mode which will be stopped when the clear leader is detected at beginning of tape.
This is the reference point for automatic search and thus the CTL counter inside the NV-A800P is reset.
Subsequently, when an entry is made (800 for example) when SEARCH is depressed the machine cycle is as follows;

1) FF until a count of 800 - 20
2) Slower FF between 800 - 20 and 800
3) AUTO STOP at 800
4) Resumed PLAY

If onthe other hand a PAUSE is made at a count of 500 and a keyboard entry made for 300 and SEARCH depressed the following events take place:

1) REW until a count of 300 + 20
2) Slower REW between 300 + 20 and 300
3) AUTO STOP at exactly 300
4) Resumed PLAY from 300

The mechanical tape counter, if ON, has priority over the search controller.

Inputs and Outputs (See schematics 1 and 2)

Inputs

B5 - CTL pulse from tape, 30Hz during normal PLAY and faster (up to 1.5KHz) during FF or REW.
B4 - Count up/down command to CTL counter IC101/102. H level for down count
B3 - Tape position indicator CLEAR signal H.
A1, A2, A3, A4 - $2^0$, $2^1$, $2^2$, $2^3$ binary weighed digit group representing 0 through 9 selected on keyboard, in BCD code.
A5 - Keyboard indicator CLEAR signal H
A6 - Shift Register (storing consecutive 4 digits entered from keyboard) ENABLE signal; it says "accept this keyboard entry"
B6 - AUTO REW H Signal
B7 - AUTO FF H Signal
B8 - H during FF, L during REW search

Outputs

A7 - This line becomes L after 4 digits are entered through keyboard. It stays L if 5th digit entry is attempted preventing its acceptance into counting system.

A8, A9 - Both lines are L , L if current tape position is equal to selected position. The respective lines are H , L if tape position is less than selected position, and L , H if tape position is greater than selected position.

A10 - Slow down signal H → L above > 0 counts away from selected count in FF and REW modes.

T0, T13, T23, T30 - timing signals which in effect say "compare tape position are digit at a five and give overall result out on lines A8, A9"

Schematic diagram No 2 P12

Inputs

CN1 - 1, 1 - 2 - 12 volt in
CN1 - 3, 1 - 4 - 12 volt ground
B2 - 5 volt
B1 - 5 volt ground
CN2 - 1 - CTL input
B5 - CTL output after Schmidt trigger slicing in IC2
CN2 - 2 - H level at biginning of tape when clear tape leader is delected
CN2 - 3 - L when cassette is lowered into position
CN2-4, - 5, - 6, - 7, - 8 - L when VTR placed into MANVAL PLAY,MAL FF, MAN REW, X2 PLAY, and SLOW PLAY modes respectively.

In the upper left side of this schematic a keyboard matrix is shown. Appropriate row/column connection is mode for digits 0 → 9 and CLEAR, SEARCH, PAUSE commands.

Outputs

CN1 - 5 - slow down command L is FF and REW modes about 20 counts before selected point. H otherwise.
CN1 - 6 - L level during PAUSE.
B3 - This signal CLEARS tape position counter during AUTO REW
CN1 - 7, - 8, - 9, - 10 - L during STOP, PLAY, FF and REW modes respectively
B4 - H for down count command, L for up count.

AUTO REW start/stop

When the cassette is insented into VTR a L signal at CASSETTE IN line will result in a L at IC 7 - 6
After the power is turned on a H appears at IC 7 - 5 from IC 4 - 3 gate.
Both actions set Flip flop IC 6/ IC 11 as shown in the figure IC 6 - 10 is L and IC11-3 is a H.

The L output sets FF IC8/IC7 placing a H on B3 line an action which clears the tape counter.
The H output turns Q10 on through D7, IC2 initiating AUTO REW mode.
During this time control line C going to EX OR IC 5 - 6 prevents MANUAL REW from interfering. MAN. PLAY or MAN FF can about AUTO REW through OR gate IC 10 - 9 , IC 13 - 4 , IC 8 - 11 reset FF IC 6 / IC 11 - 3 . This FF is also refer by begining of tape signal CN2 - 2
IC13 - 12 and IC8 - 10.
As a protection AUTO REW mode is stepped in case CASETTE IN is H as would be the case when a cassette sensing switch is malfunctioning.

Keyboard

When a key is pushed, "6" for example, the base of Q3 is pulled down and a H appears at its collector going to IC25 - 4 . At the same time keyboard terminal 6 goes H enabling IC26 - 11 .
Four D-type Flip-flops, IC23 and IC24 are used to memorize keyboard column and IC21 and IC22 store the row corresponding to the key depressed.
Or gate IC20 - 1 routs the signal from keyboard to CL (clear) imputs on all flip-flops. Resister R33 and C13 eliminates switch bounce while C15 and R38/39 permits these flip-flops to be initially cleared at power turn-ON.

The AND gates driving T (toggle) inputs of flip-flops are driven not only by keyboard signals but also by the other 3 flip-flops. A particular gate will be enabled only if keyboard entry is made AND the other flip-flops are reset.
Once the entry is made into ROW and Column memory, IC20 - 1 resets all flip-flops and the next entry can be made. Note that because of feedback two simultaneous keyboard entries are inhibited eliminating confusion.
The outputs from Row/Column memories are coded in BCD code,

A1 - $2^0$ output of IC18 - 3
A2 - $2^1$ output of IC18 - 4
A3 - $2^2$ output of IC23 - 13
A4 - $2^3$ output of IC24 - 1

representing a number between 0 and 15 (only 0 - 9 used)
when key "6" is depressed A1 = L , A2 = H , A3 = H and A4 = L .

Note that when SEARCH, CLEAR, or PAUSE button, are pressed IC17 - 3 , IC -17 - 4 , or IC17 - 11 become H respectively.
For example when SEARCH is depressed, IC28 - 13 toggles IC21 - 13 and IC - 27 - 13 toggles IC24 - 13 enabling IC17 - 3 passing through IC14 - 3 setting the SEARCH flip-flop (IC14 - 11 is H , IC14 - 10 is L ).
The SEARCH flip-flop may be reset by CLEAR button (signal from IC17 - 4 ), any MANUAL command (signal for IC13 - 4 , IC8 - 9 ), power turn-ON (IC4 - 3 , IC8 - 9 ), and cassette-in signal when the cassette is not in VTR or when cassette-in switch malfunctions (IC1 - 10 , IC8 - 9 ). And these signals pass through IC16 - 9 to reset SEARCH flip-flop.

Selected position

Indicator clear - A5 output

IC6 - 3 is normally H . When a CLEAR key is pressed IC17 - 4 becomes H which inverts in IC6 - 3 . This L becomes H at IC15 - 4 which is the A5 output.
A5 line is used to reset the shift resister SR on Schematic No.1. The SR is a serial memory which not only stores the selected numbers but also their sequence.
The same action occurs when the cassette is initially inserted through IC1 - 10 , IC13 - 10 , IC7 - 4 , and IC6 - 3 , etc.
Power turn ON will also do the same through IC4 - 3 , IC7 - 4 , IC6 - 3 , etc.

PAUSE ON/OFF control

During the SEARCH mode PAUSE is inhibited by a L out of IC14 - 10 which causes a H on IC9 - 9 and L on IC9 - 10 . Note that bias from R79 keeps Q6 OFF (or is NOT PAUSE state). When SEARCH mode is ended a H sets PAUSE flip-flop (i.e. IC9 - 4 becomes H ) This action doesn't affect Q6. When PAUSE key is pressed at this time IC17 - 10 goes H while IC9 - 1 is also H . At this time both IC9 - 3 and 4 go L , L but IC9 - 10 goes H but Q6 still stays OFF.
Due to differentiation effect of C28/R69 IC9 - 6 after a while goes L for a short duration but IC9 - 1 stays H resulting is a L to H transition at IC9 - 4 . This results is a short positive pulse at IC9 - 10 . The trailing edge of this pulse turns on Q6 which is turn toggles a flip-flop in the VTR deck placing it into PAUSE mode.
STOP. Also a L from IC11 - 11 going through IC11 - 10 and IC2 - 2 turns on Q8 and PLAY mode ensues.

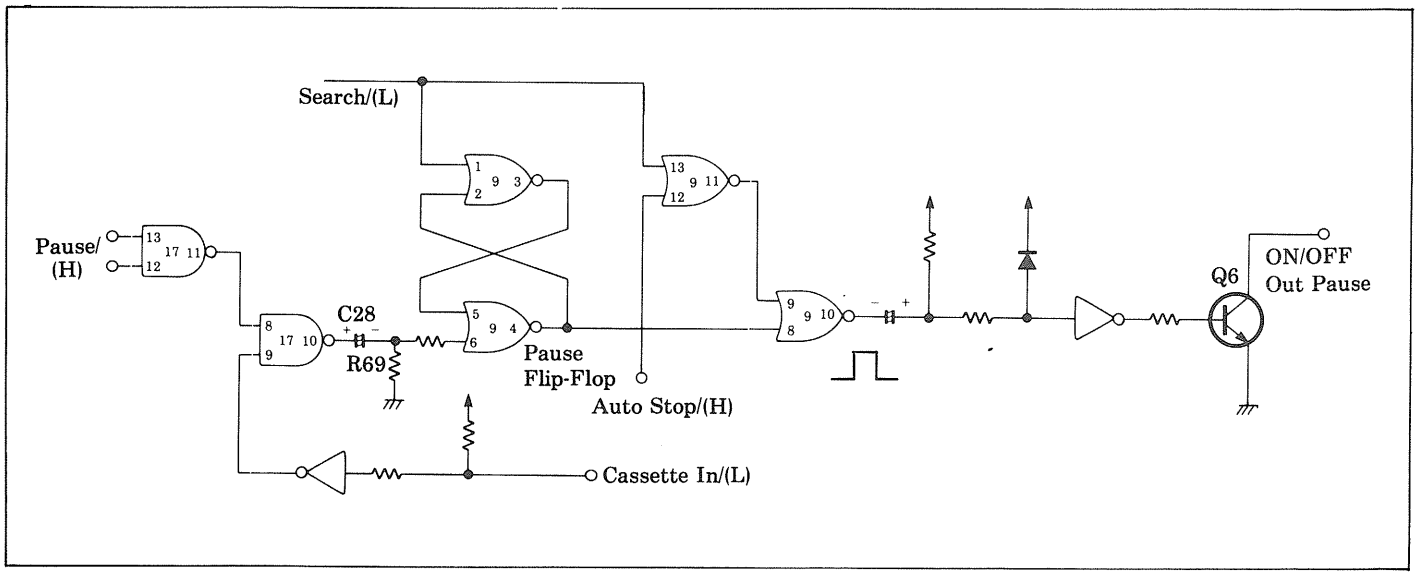



Fig. 139

Tape Position Indicator CLEAR - B3

Tape position indicator is reset to "0" when B3 line goes H .
This happens when IC8 - 6 /IC7 - 3 flip-flop is set by

1 beginning of tape signal reaching IC8 - 3 or
2 AUTO REW start/stop flop-flop through IC8 - 4 when set. This happens on power turn-ON and when cassette is inserted into VTR.
This flip-flop is cleared during MANUAL PLAY FF, REW, X2 PLAY, and SLOW PLAY.

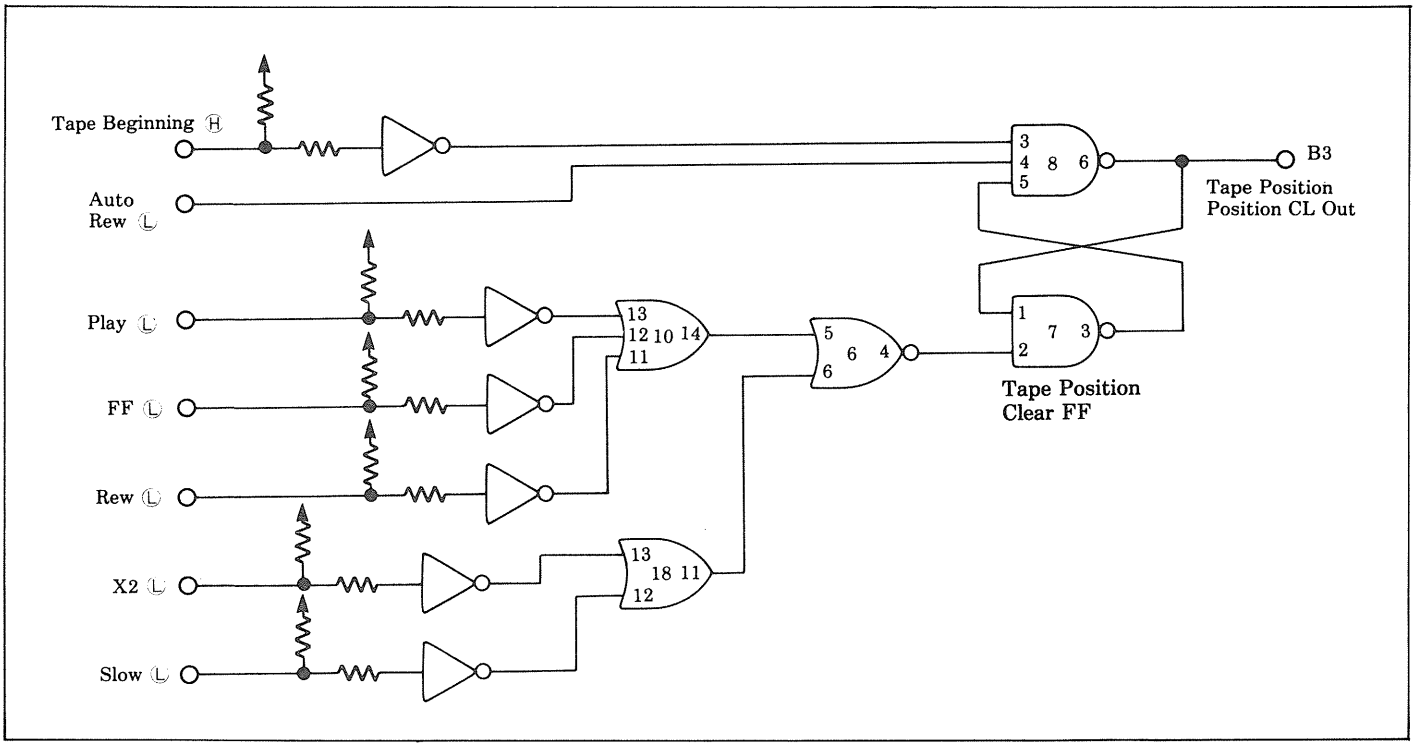



Fig. 140

Counter Up/Down Control

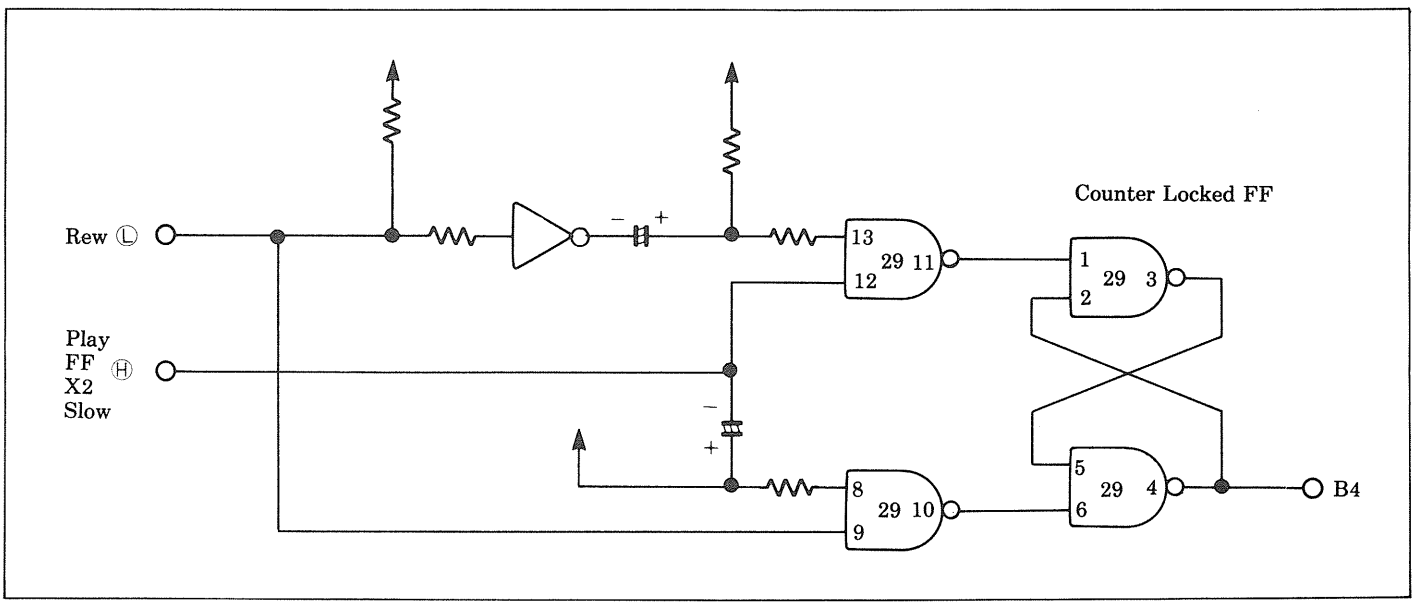



Fig. 141

In the PLAY, FF, X2 PLAY, and SLOW PLAY the tape moves forward and the counter should count up. If should count down only when tape reverses motion, i.e. REW mode.
This control is done by B4 line. During forward motion IC20 - 13 is H which sets Counter Control FF IC29 - 3 /IC29 - 4 i.e. pin (3) is H and B4 is L . This low as it reades IC101/IC102 Up/down counters makes them count up via a H at IC103 - 6 .
During REW Counter Control FF is reset and an up count is carried out.

AUTO STOP and AUTO PLAY

When power is ON, no MAN command given, and when cassette drops into place a H at IC8 - 9 sets IC3 - 9 /IC11 - 11 flip-flop. Drives to both Q7 and Q8 are not applied and they are OFF resulting in as action.
During the search made either FF or REW is in progress depending on tape position with respect to desired position. This into is coded on A8, A9 lines.

| | Tape pos < sel pos | Tape pos > sel pos | Tape pos = sel pos |
|---|---|---|---|
| A8 | H | L | L |
| A9 | L | H | L |

As soon as tape position is equal to selected position A8 = L A9 = L and either of these modes is released through a H at IC12 - 4 or H at IC12 - 10 which turn OFF Q9 or Q10.
At this time IC16 - 10 becomes H which resets Auto Stop/Play FF i.e. IC3 - 9 is H and IC11 - 11 is L . A spike made by C30/R74 turns on Q7 which causes

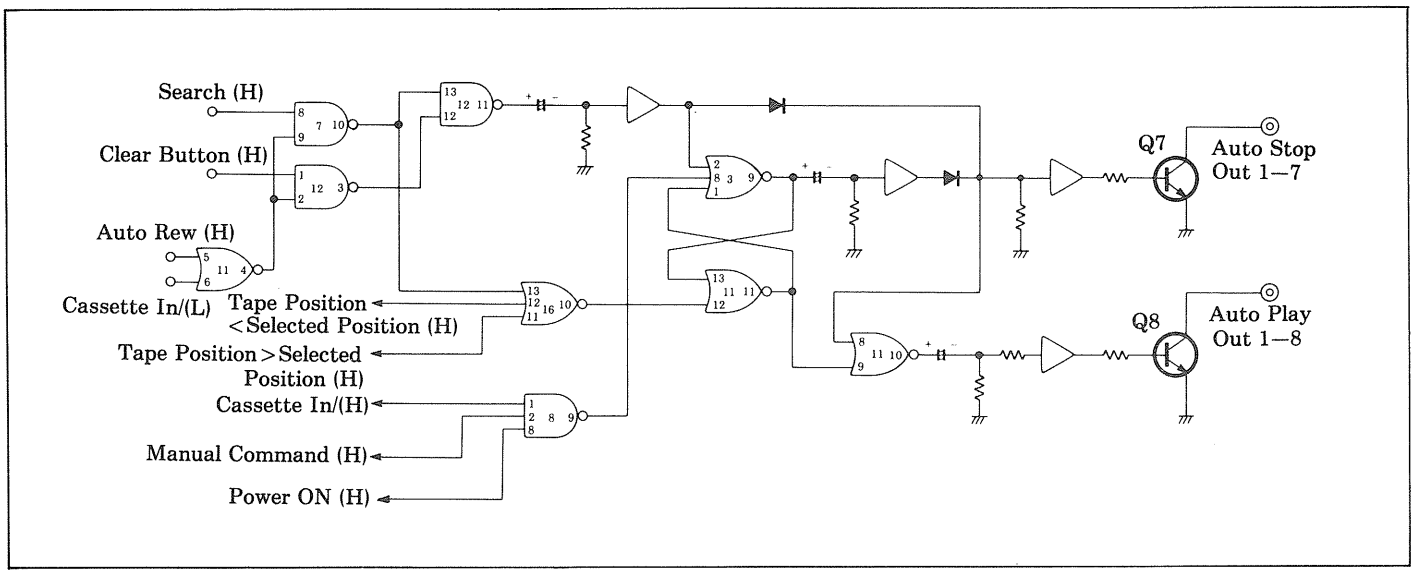



Fig. 142

FF/REW Slowdown

When tape position approaches the selected position (about 20 counts away) the selected position (about 20 counts away) the transport is slowed down in preparation for AUTO STOP and AUTO PLAY.
During the AUTO REW mode the current tape position is compared to selected position XXXX + 20 on a digit by digit basis in IC123 starting with the most significant digit first (MSD).
Normally in REW the tape position is greater than selected B > A in IC123 i.e. pin (7) is H and pin (5) is L . Since IC125 D-type flip-flops as initially reset a low on to entering IC122 - 11 will clock in this information into IC125 (IC125 - 1 is L and IC125 - 13 is H ). Even though only the MSDs were compared with new information with be able to enter D flip-flops since IC122 - 10 cannot become H because of a H on IC125 - 13 .
For 4-digit comparison to makes its appearance 4 times after which T30 resets IC125 ffs and transfers IC125 converts into IC129 D-type flip-flop pair.
The output at A10 is H indicating to proceed in REW mode at full speed.
When tape position is equal to selected position XXXX + 20 neither B > A nor A > B and both pins (5) and (7) of IC123 become L , L . This information when clocked to the output of IC125 and then to IC129 - 1, 13 → L , L with force A10 to L causing REW slowdown by turn ON of Q5.
Before slowdown command B8 is L (adder capacity of 9999 not exceeded IC124, 128, 132, 133) and IC5 - 9 is H making IC5 - 10 H .
Since A10 is also H at this time IC4 - 11 is L keeping Q5 OFF.
When A10 becomes L IC4 - 11 changes and turns QN Q5 which slows down tape motion.
During FF mode tape position is compared not to desired position YYYY but to YYYY + 9979 due to a H at IC108 - 3 which forces A1 A2 A3 A4 to 1001 in LSD decade1110 in 2nd decade, 1001 in 3rd and 4th decades.
If YYYY is less than 22 (i.e. tape position is already close to desired) slow FF ensures. If YYYY is further away from desired position an adder overflow condition results i.e. B8 → H .

YYYY = 0400
400 + 9979 = 379 + carry on B8

The magnitude comparator IC123 works as previously described and at count coincidence A = B will again cause IC107 - 10 to become L slowing the tape in preparation for STOP.
In this case IC5 - 9 is L but B8 is H resulting in IC5 - 10 H . Transistor Q5 is again held OFF during FF but is turned ON when A10 becomes L as desried position is approached.
Magnitude comparator IC118 compares keyboard entry against tape position is a similar fashion (no 20 offset here) and through IC126/IC130 D-type flip-flops affects A8/A9 lines.

| | Tape pos < sel pos | Tape pos > sel pos | Tape pos = sel pos |
|---|---|---|---|
| A8 | H | L | L |
| A9 | L | H | L |

Selected position Memory Entry (Schem Diagr 1)

When a key is pressed at the keyboard a BCD digit will be encoded on Row/Column select flip-flops A1 = $2^0$, A2 = $2^1$, A3 = $2^2$, A4 = 2 (For digit 9 A1 = H A2 = L , A3 = L , A4 = H ).
These are simultaneously presented to Shift Register (SR) inputs IC116 - 7, IC116 - 15 , IC120 - 7 and IC120 - 15. A short time later a SHIFT pulse appears at IC108 - 4 transfering this information to $A_0$, $B_0$, $C_0$, $D_0$ respectively.
When the next digit is keyed in A1 - 4 information is again transfered to $A_0$, $B_0$, $C_0$, $D_0$ but at the same time $A_0$ - $D_0$ information is shifted to $A_1$, $B_1$, $C_1$, $D_1$ positions.
This sequence is repeated 4 times, when a fifth entry is attempted A7 signal is L preventing A6's appearance by resetting IC15 - 11 / 10 flip-flop and enabling or gate IC10 - 6 making A6 L .
During the SEARCH mode A7 doesn't charge.
When a CLEAR button is pressed however, IC17 - 4 is H which makes A5 H through IC6 - 3 and IC15 - 4 . This signal resets the SR to 0.

Selected Position Data Selector/Multiplexer

Two IC115 and IC119 sections are used to transfer data from inputs Xo - X , Yo - Y is Z outputs which are connected to digited magnitude comparator IC118 positions Xo, Yo are least significant bits (LSB) on BCD coded 4 digit groups.
This transfer of information is under control of T13/T23 select lines.
To pulse is used to transfer one digit magnitude comparison result into D inputs of D-type flip-flops IC126 - 1 /IC126 - 13 . This information is subsequently transfered to the other 2 D-type flip-flops IC130 - 1 /IC130 - 13 during T30 pulse time. IC122 - 6 is H only during MSD comparison and if the two digits are equal.
Eventually when all 4 digits representing selected position are compared to current tape position (from 4-bit scanning counter IC109) A8/A9 outputs appear coded as follows

| | Tape pos < sel pos | Tape pos > sel pos | Tape pos = sel pos |
|---|---|---|---|
| A8 | H | L | L |
| A9 | L | H | L |

Another magnitude comparison is carried out in IC123 which is being driven by a similar set of 4-channel selector/multiplexer chips IC131/IC127.
In this case however the convert tape position is not compared to selected position XXXX but to selected position plus 20 in REW mode and selected position plus 9979 in FF mode.
When FF is in progress (i.e. tape position < selected position B6 is L which makes IC108 - 3 H. You can see that BCD adders IC133/IC132/IC128/IC124 get immediate input 9979. (or $A_1$ ..... $A_4$ lines)

In REW mode B6 is H , IC108 - 3 is L and only 0020 is introduced into the BCD adders on A1 - A4 inputs.
Thus if 400 is convert tape position and 100 is the selected position IC123 magnitude comparator will compare 400 to 120 rather than 100 in REW mode. When 120 count is reached a L appears at IC107 - 10 indicator a SLOWDOWN signal i.e. normal REW speed is reduced in preparation for AUTO STOP → resume PLAY.
However if 500 is the convert tape position and the desired selected position is 600 AUTO FF will take place. The number 9979 is added to 500 resulting in 579 and a H on B8 line (CARRY output from IC133).

Thus actually 579 is compared to 500 rather than 600 to 500 in the magnitude comparator IC123. When tape position becomes greater than 579 IC107 - 10 with also go L indicating SLOWDOWN condition.
Thus will occur 20 counts before 600 and tape speed is reduced in preparation for AUTO STOP → resume PLAY.

CTL Countdown

B5 input carries CTL pulses through a digital Schmidt trigger IC103 - 12/IC103 - 15 to CLOCK input of Up/Down Counter IC102/IC101.
The counter is initially cleared via B3 line through IC107 - 11 /IC103 - 10 .
For an up count B4 line is L . This L presets both counter as 0000/0000 condition through $A_1$ $B_1$ $C_1$ D inputs. The counter counts 0 → 1 → 2 ... 9 → (0 and carry 1) etc. The second also goes through same sequence but as soon as it reaches "3" Q21 is H and Q22 is H IC106 - 11 becomes H which gives one clock pulse to 4-bit scanning counter and resets (clean) IC102/101 through inputs 9 via IC103 - 4 /IC103 - 2 /IC107 - 11 and IC103 - 9.
The counter thus goes through a 30 CTL cycle before being reset i.e. if counts 30 CTLs as a group during on up count.
During a down count B4 is H only prefering the number 29 on preset inputs $A_1$ $B_1$ $C_1$ $D_2$. The counter is similarly cleared by B3 line H so that it holds digit 00 initially. The first CTL pulse with cause IC102 to assume 1001 state at Q11, 12, 13, 14 outputs and introduce a BORROW H as carry out line IC102 - 7. This causes IC101 to also assume 1001 (Q21 - 24) or digit 9 (Counter holds count of 99) And gate IC106 - 10 becomes H providing one clock pulse to IC109 as well as causing LOAD command i.e. $A_1$ $B_1$ $C_1$ D codes are loaded into counter or the digit 29.
In effect the first CTL pulse causes counter to go from 00 → 29. The second etc. couse it to count down 29 → 28 etc. until 00 is reached and the entire sequence is repeated.

4-bit scanning Tape Position Counter

IC109 monitors UP or DN CLOCK (i.e. CTL pulse or tape position) at a rate or approximately 9500 Hz determined by C104/R137 defining scanning clock frequency. This information is BCD coded on output lines $A_1$ $B_1$ $C_1$ D representing convert tape position in terms of playing time seconds. The BCD code is introduced to IC110 BCD to 7-segment decoder/driver which in turn is connected to cathode driver D101/102/103/104, IC109 - 20, 21 , 22 , 23 outputs strobe the units, tens, hundreds and thousands display elements at a very fast rate so that display flicker does not occur.
A similar drive/strobe combination is designed to display selected position IC118 (outputs) B1, B2, B3, B4 lines which are connected to IC112 BCD to 7-segment decoder/driver which in turn are tied to D105/106/107/108 cathode drivers.
Output lines T13, T23 are related to IC109 $10^0$, $10^1$, $10^2$, $10^3$ outputs as follows

| | | T13 | T23 |
|---|---|---|---|
| Units | $10^0$ | L | L |
| Tens | $10^1$ | H | L |
| Hundreds | $10^2$ | L | H |
| Thousands | $10^3$ | H | H |

These T13, T23 lines are used to strobe IC115/IC119 selectors multiplexers causing IC118 magnitude comparator to receive $10^3$ digit first, $10^2$ digit second etc. for digit-by-digit comparison will of selected position with current tape position.

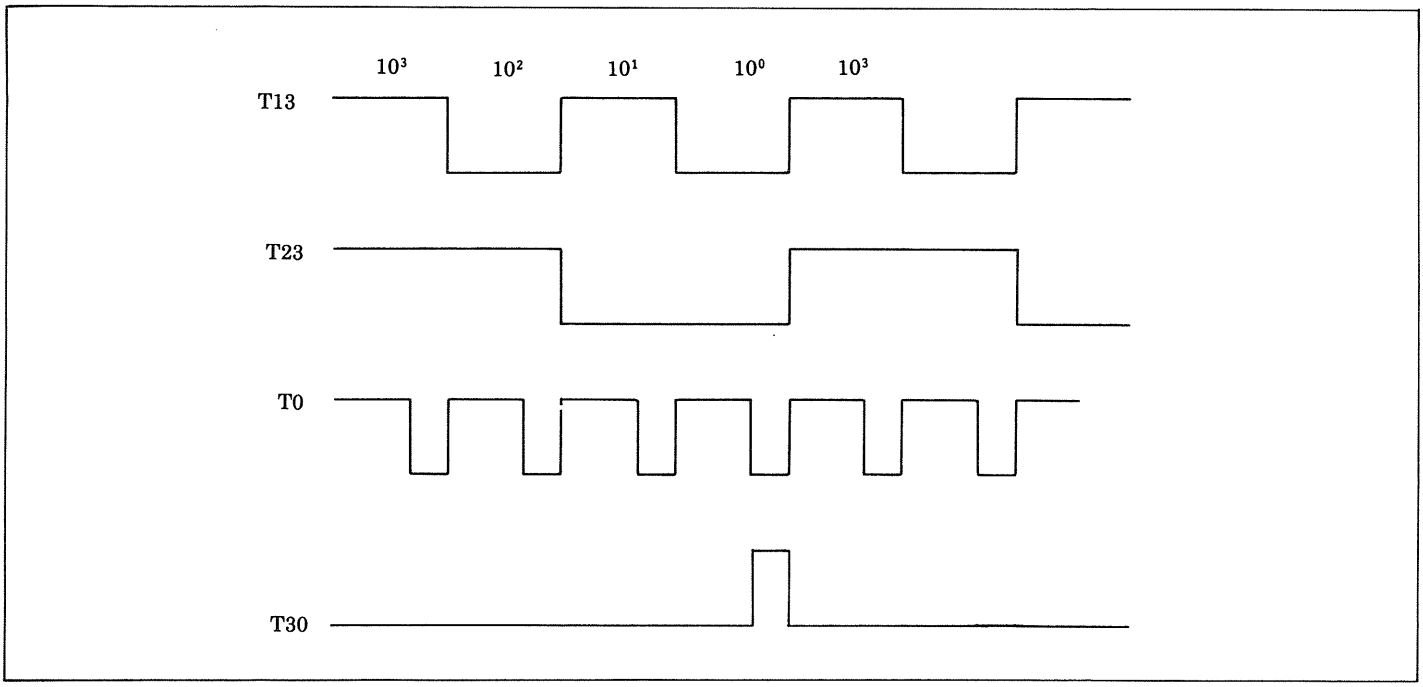



Fig. 143

To signal is used to transfer IC118 comparison results into IC126 D-type flip-flops while T30 is used to pass information from IC126 to IC130 D-type flip-flops causing A8, A9 to assume a 2-bit code which relates tape position and selected position.

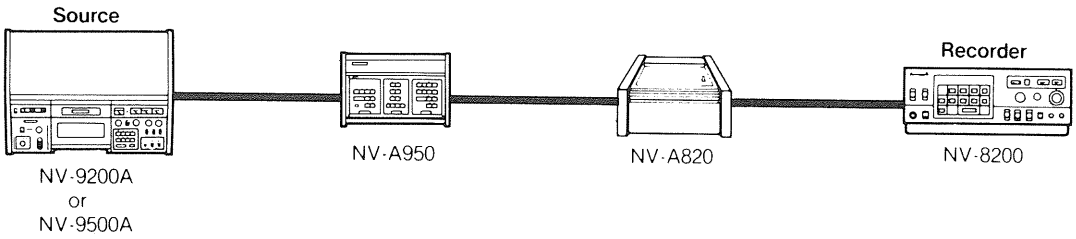
## INTERFACE ADAPTOR MODEL NV-A820

The adaptor is used as an auxilliary Component to NV-A950 NV-9000/A - series Editing Controller in order to make automatic editing possible between

1) NV-8200 (one source and one editor)
2) NV-8200 (editor) and NV-8170 (source)
3) NV-8200/8170 (source) and NV-9500/A (editor)
4) NV-9500/A, NV-9200/A (source) and NV-8200 (editor)

Typical Editing System Using Interface Adaptor NV-A820 & their Function

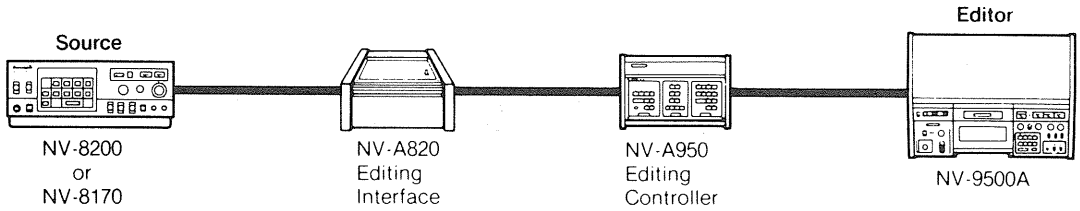
### 3/4″ to VHS Assembly




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| NV-A950 | CONTROL | EDIT START | ○ | NV-A950 | EDITOR | PAUSE | ○ |
| | | REHEARSAL IN<br>REHEARSAL RETURN | ×<br>× | | | SEARCH<br>SLOW REWIND | ○<br>○ |
| | | ASSEMBLY<br>CUT IN | ○<br>× | | | PREROLL<br>PREROLL LAMP | ○<br>○ |
| | | ENTRY<br>EXIT | ×<br>× | | | STAND-BY LAMP | × |
| | | ENTRY→RESET<br>EXIT→RESET | ×<br>× | | SOURCE | FF<br>FWD | ○<br>○ |
| | EDITOR | RECORD<br>EDIT | ○<br>○ | | | REW<br>X2 | ○<br>○ |
| | | CUT IN<br>CUT OUT | ×<br>× | | | STOP<br>PAUSE | ○<br>○ |
| | | FF<br>FWD | ○<br>○ | | | SEARCH<br>SLOW REWIND | ○<br>○ |
| | | REW<br>X2 | ○<br>○ | | | PREROLL<br>PREROLL LAMP | ○<br>○ |
| | | STOP | ○ | | | STAND-BY LAMP | ○ |

Fig. 144

## VHS to 3/4″ Editing




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| NV-A950 | CONTROL | EDIT START | ○ | NV-A950 | EDITOR | PAUSE | ○ |
| | | REHEARSAL IN | ○ | | | SEARCH | ○ |
| | | REHEARSAL RETURN | ○ | | | SLOW REWIND | ○ |
| | | ASSEMBLY | ○ | | | PREROLL | ○ |
| | | CUT IN | ○ | | | PREROLL LAMP | ○ |
| | | ENTRY | ○ | | | STAND-BY LAMP | ○ |
| | | EXIT | ○ | | | | |
| | | ENTRY→RESET | ○ | | SOURCE | FF | ○ |
| | | EXIT→RESET | ○ | | | FWD | ○ |
| | EDITOR | RECORD | ○ | | | REW | ○ |
| | | EDIT | ○ | | | X2 | ○ |
| | | CUT IN | ○ | | | STOP | ○ |
| | | CUT OUT | ○ | | | PAUSE | ○ |
| | | FF | ○ | | | SEARCH | ○ |
| | | FWD | ○ | | | SLOW REWIND | ○ |
| | | REW | ○ | | | PREROLL | ○ |
| | | X2 | ○ | | | PREROLL LAMP | ○ |
| | | STOP | ○ | | | STAND-BY LAMP | × |

Fig. 145

---

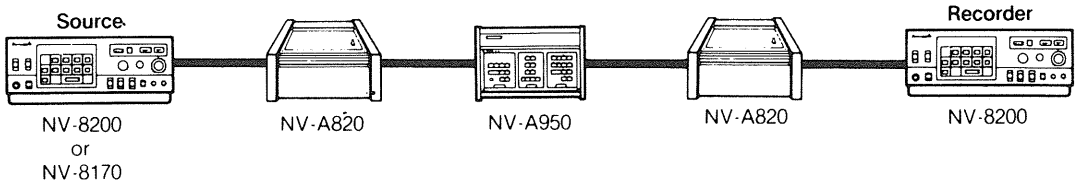
The NV-A820 passes commands between NV-A950 and NV-8200/8170 as though VHS VTRs were 3/4" machines. There are some basic differences which are mentioned below:

A) SLOW REW is carried out in the threaded position, always preceeded by PAUSE in NV-9000/A series. In contrast NV-8200/8170 does not have an independent SLOW REW function. It is rather a slowed down REW done in the sub-loaded position (not fully threaded). Normal REW is slowed down by $\frac{1}{3}$.

B) In NV-9000/A series X2 and SLOW speed are accomplished by control of servo circuits during the PLAY mode.
In NV-8200/8170 there modes are independent and separate logic handling is required.

C) When NV-8200 is used as an Editor and an Edit command is issued on NV-A950 the NV-A820 will translate this into REW SW ON command which when it enters NV-8200 will place it into REC mode and switch servo reference to incoming V Sync.

## VHS to VHS Assembly




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| NV-A950 | CONTROL | EDIT START | ○ | NV-A950 | EDITOR | PAUSE | ○ |
| | | REHEARSAL IN | × | | | SEARCH | ○ |
| | | REHEARSAL RETURN | × | | | SLOW REWIND | ○ |
| | | ASSEMBLY | ○ | | | PREROLL | ○ |
| | | CUT IN | × | | | PREROLL LAMP | ○ |
| | | ENTRY | × | | | STAND-BY LAMP | × |
| | | EXIT | × | | | | |
| | | ENTRY→RETURN | × | | SOURCE | FF | ○ |
| | | EXIT→RETURN | × | | | FWD | ○ |
| | EDITOR | RECORD | ○ | | | REW | ○ |
| | | EDIT | ○ | | | X2 | ○ |
| | | CUT IN | × | | | STOP | ○ |
| | | CUT OUT | × | | | PAUSE | ○ |
| | | FF | ○ | | | SEARCH | ○ |
| | | FWD | ○ | | | SLOW REWIND | ○ |
| | | REW | ○ | | | PREROLL | ○ |
| | | X2 | ○ | | | PREROLL LAMP | ○ |
| | | STOP | ○ | | | STAND-BY LAMP | × |

**Fig. 146**

Play lamp Memory

When the FWD button of NV-A950 is pushed, the PLAY mode is memorized and the FWD lamp will light.
This signal also is supplied to NV-8200 for commanding the PLAY mode. When STOP, FF or REW buttons are pushed at this time, the play memory will be released and the lamp turned off.
In case of NV-8200, the machine will stop after sub unloading is completed.
This play memory is kept on during the X2, SLOW and SLOW REW mode.

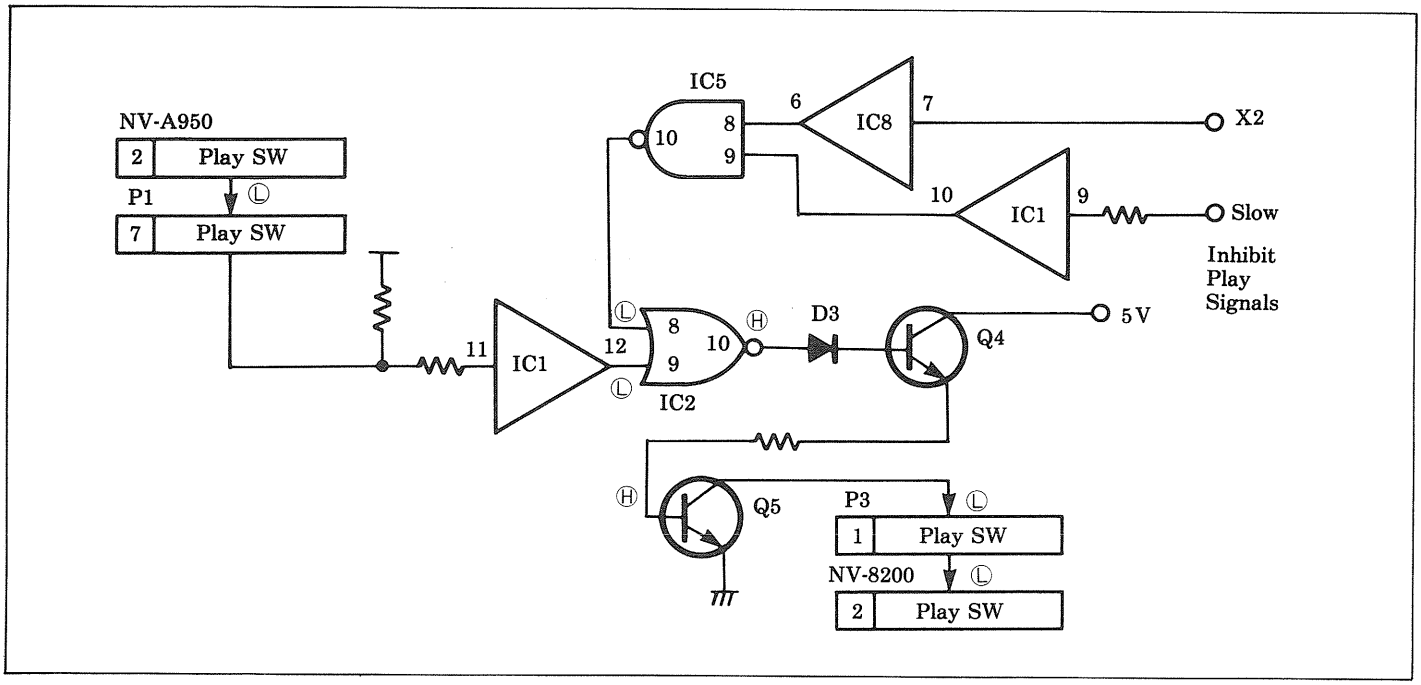



Fig. 147

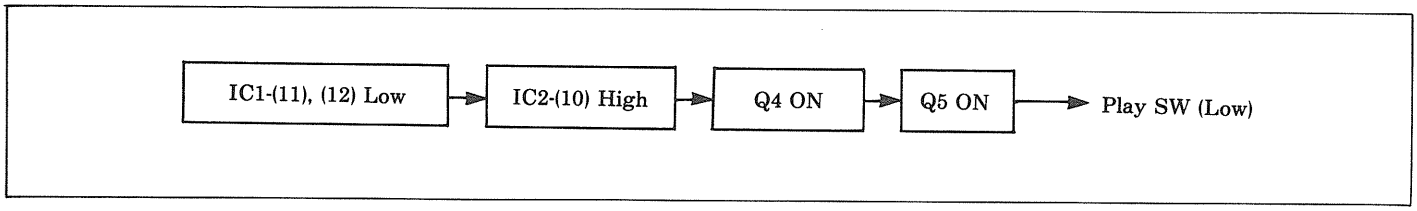



Fig. 148

According to Fig.147 and Fig.148, when play button of NV-A950 is pushed, low level signal appears at IC1 - 11 through P1 - 7 . And finally, Q5 turns on to put the play mode on NV-8200. The detailed process is shown in Fig. 148
When X2 or Slow button of NV-A950 is pushed, play button is prohibited by the NAND GATE which is connected with IC2 - 8 .
If NV-8200 is in the play mode, the memory is set by the play hold and then it drives Q1 and Q2 to light the LED FWD LED (DU6) which is on the front panel of NV-A950.

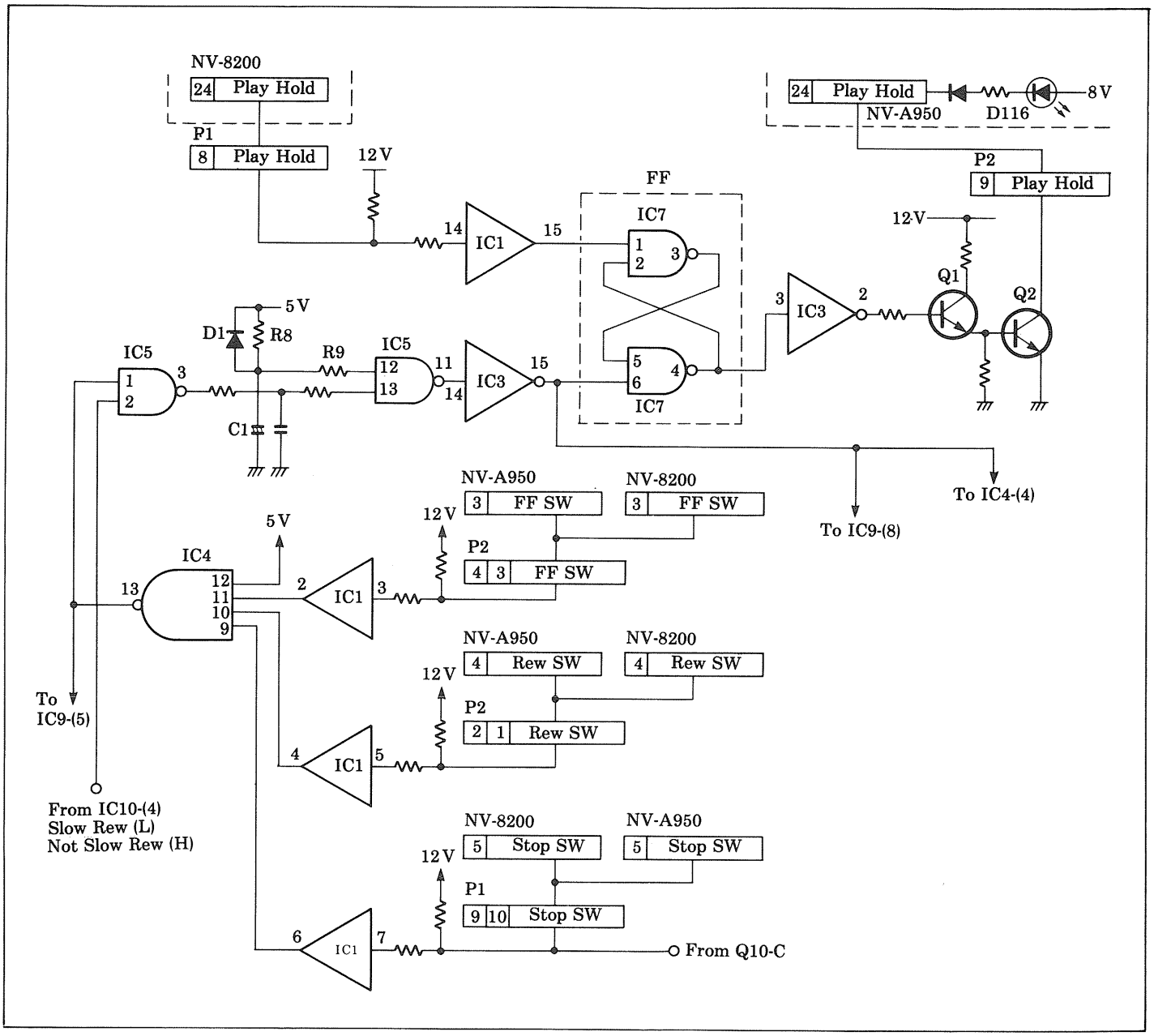



Fig. 149

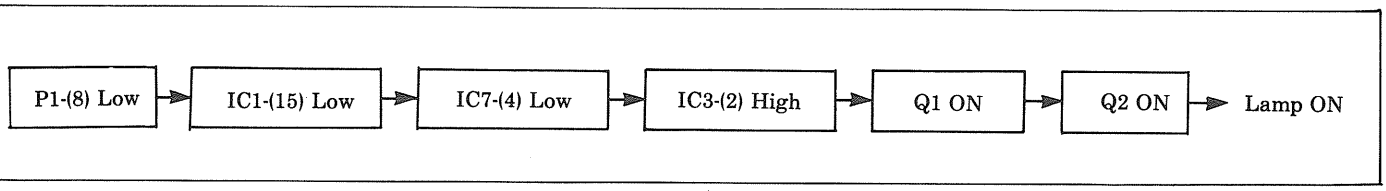



Fig. 150

The process is indicated in the above diagram. Play mode is memorized by FLIP-FLOP inside of IC7 1 ∿ 6 . This play memory is the same during X2, SLOW or Slow REW mode. This memory may be reset by Rew, FF, STOP through IC4 - 13 at power turn-on memory is cleared due to delay is C1/R8.
The L at IC3 - 15 does the following:

1 it resets the PLAY HOLD flip-flop → turns OFF Q1/Q2 during power turn-on, or during FF, REW, STOP so that these functions may be enabled

2 it resets PAUSE HOLD flip-flop by a H on IC9 - 10 and keeps it reset IC6 - 2 is H . In this case pause cannot be memorized and Q7/R8 can only be on if the PAUSE button is held down. As soon as it is released, so is PAUSE mode.

3 it resets Edit Start ff IC4 - 1 goes H and Q11 turns OFF

X2

When the X2 button is pushed during FWD mode of NV-A950, the mode becomes X2 mode. And then play mode is returned from X2 mode by a second pushing of X2 button.

Slow mode is also the same as X2 mode.

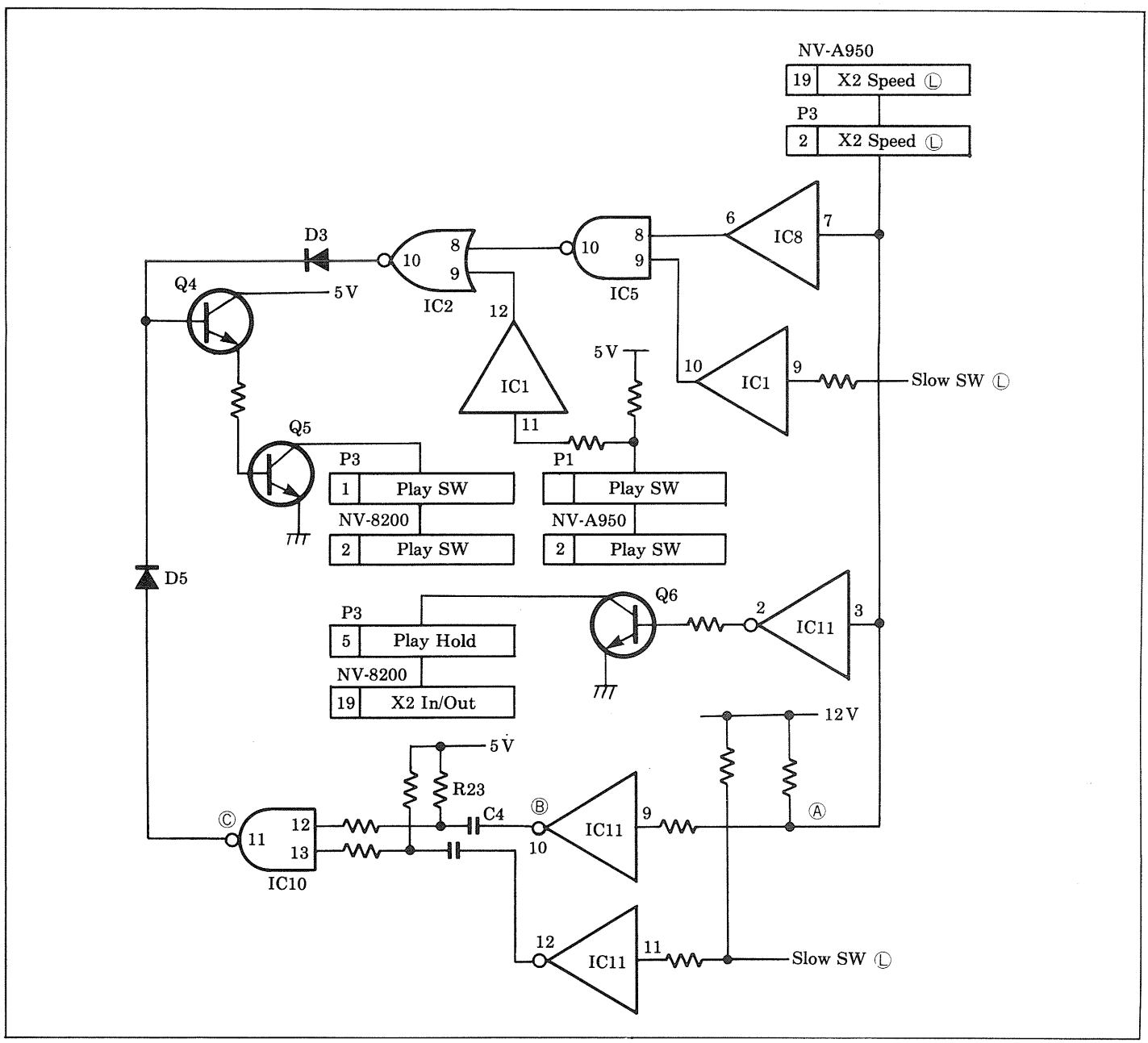



Fig. 151

When the X2 button of NV-A950 is pushed in the FWD mode, a low level signal appears at IC11 - 3 . This low level signal turns Q6 on, which is connected parallel with the X2 switch. So X2 mode is kept by this process.
At the same time, low level signal at IC8 - 7 turns Q5 off which prohibit play mode during X2 or slow mode in case of NV-8200.

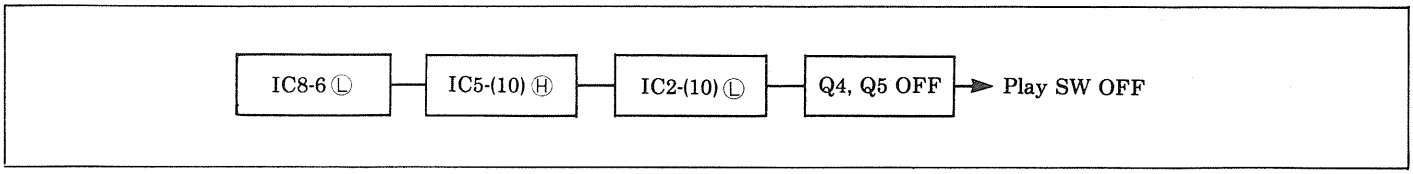



Fig. 152

After above mentioned is performed, play mode is reset automatically as shown in Fig. 153.

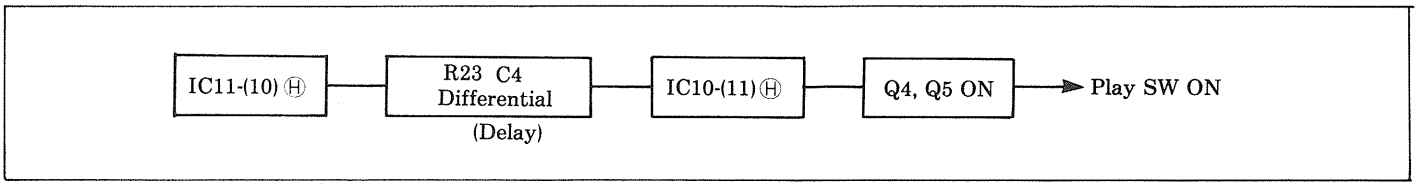



Fig. 153

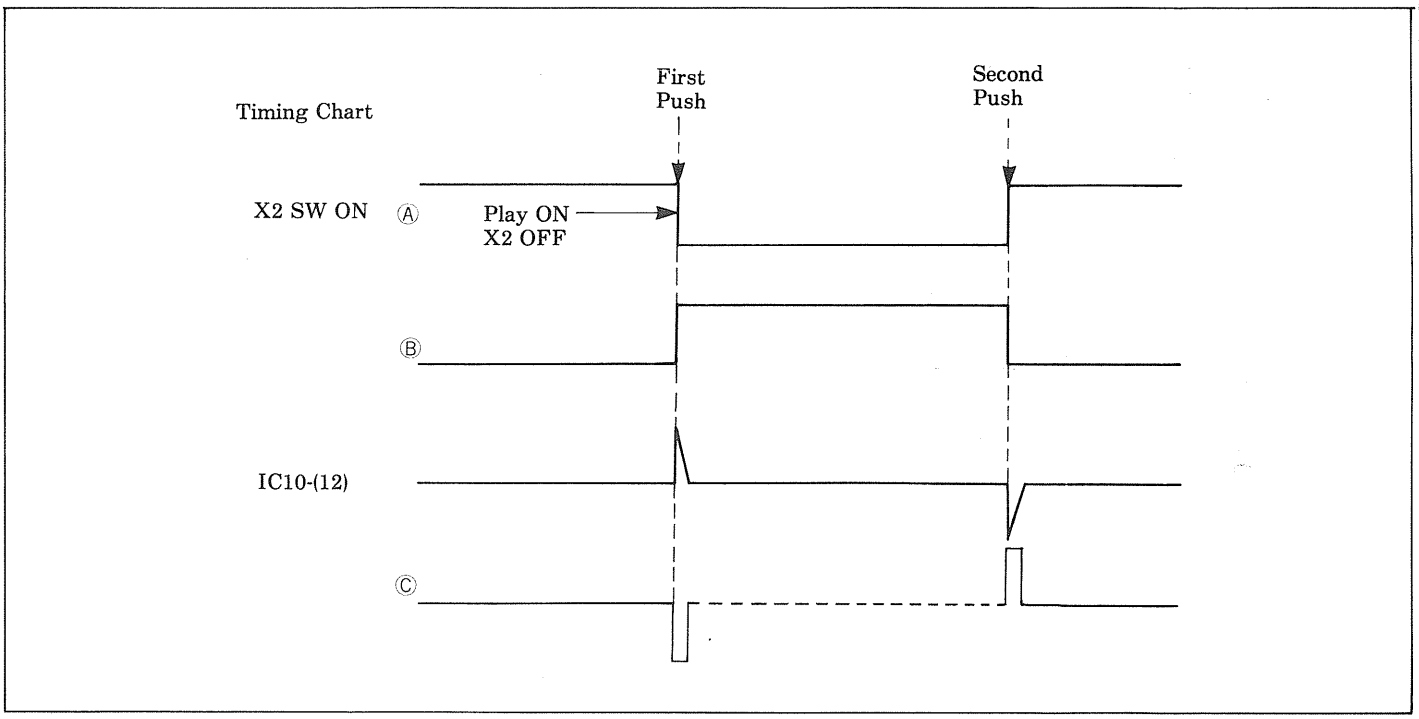



Fig. 154

Slow Mode

When Slow button of NV-A950 is pushed, low level signal appears at IC1 - 9 , and finally this signal turns Q9 on to enter slow mode in NV-8200.

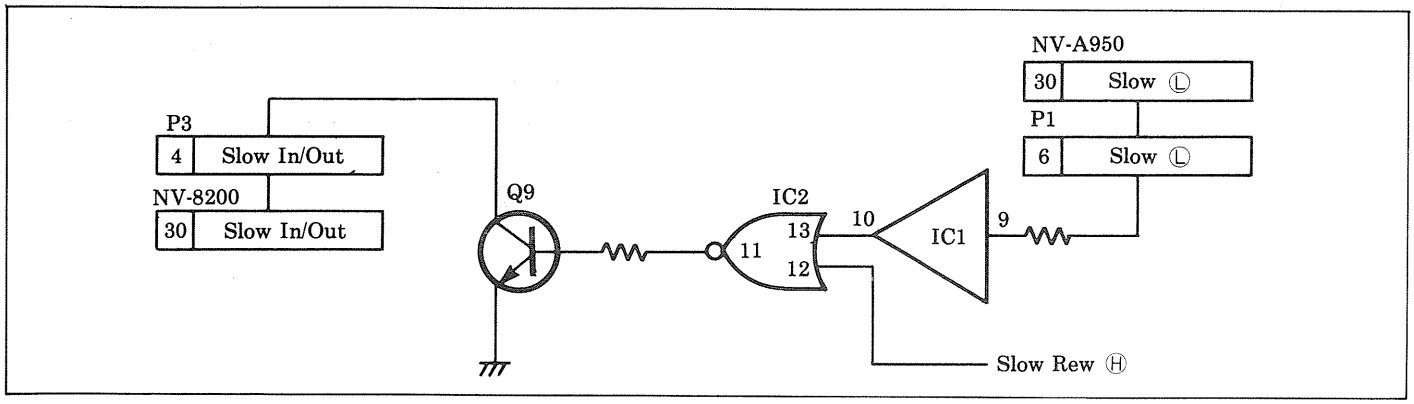



Fig. 155

Therefore, IC1 - 9 L → IC2 - 11 H → Q9 ON → SLOW SW ON.
When slow SW is on, play mode is prohibited through IC2 - 10 the same as X2 mode. Then play mode is reset through IC10 - 11.

Slow Rew Mode
When slow button is pushed from FWD → Pause mode of NV-A950, FWD. Pause, Rew and Slow Rew lamps turn on. At the same time, unloading is starting.
After unloading is completed, Rew speed slows down to 1/3 at normal speed.
When slow Rew button is released, the mode returns to pause mode after realizing FWD lamp lighting and loading action.
In this case, noiseless still image can be seen on the TV monitor.
When slow Rew button is pushed from search pause mode, FWD, Pause, Search, Rew and slow Rew lamps are lit. After releasing the slow Rew button, search pause will return again.

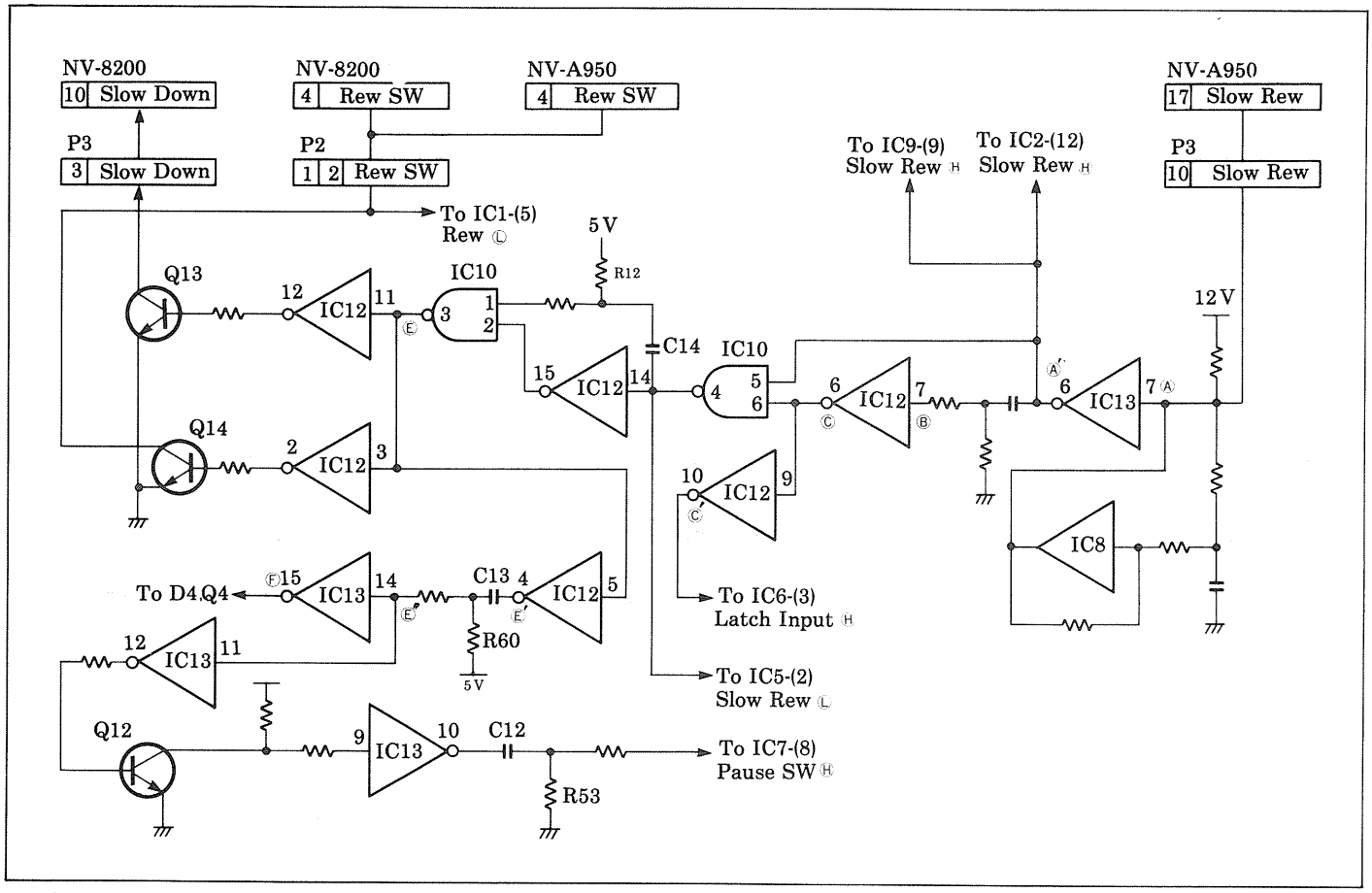



Fig. 156

NV-8200 doesn't have slow Rew button so slow Rew signal from NV-A950 has to be adapted by interface adaptor, NV-820, to make possible the slow Rew action.
If Rew mode and slow Rew mode are possible, preroll action also can be performed.

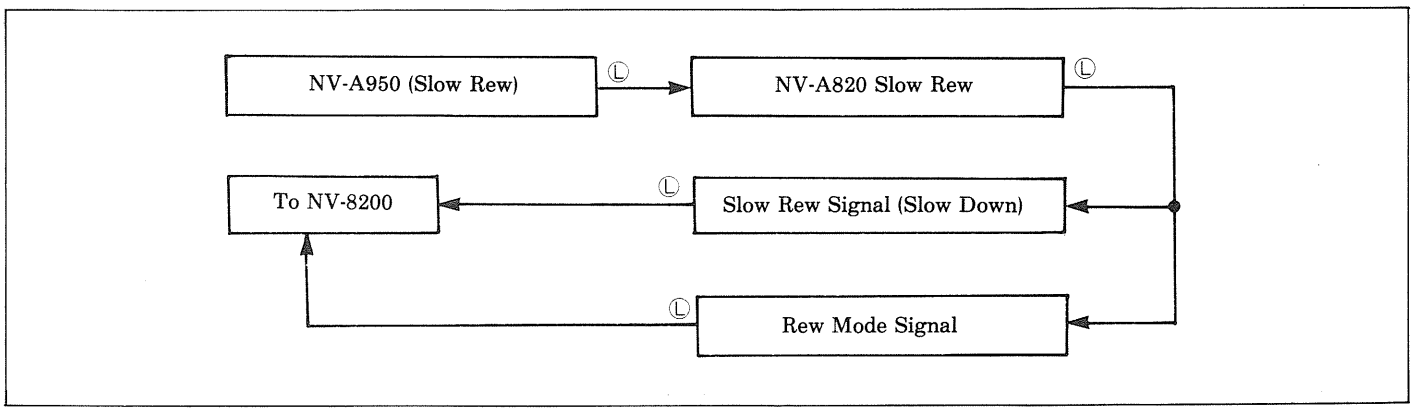



Fig. 157

When slow Rew button of NV-A950 - 17 is pushed, a high level signal appears at IC13 - 6 through the connector P3 - 10 , IC13 - 7 .
This high level signal is supplied to IC10 - 5 directly. Also this is supplied to IC12 - 7 through C5, R64 which is differentiated.
Now, positive pulse is obtained at IC12 - 6 which goes into IC10 - 6.

IC10 - 5 H
IC10 - 6 H → IC10 - 4 L
L low level can be obtained after one moment

IC10 - 4 L → IC10 - 1
→ IC12 - 14 → IC10 - 2 → IC10 - 3 L
Delayed one moment

IC10 - 3 L → IC12 - 11 , 12 → Q13 ON → L slow down signal
Capstan motor rotates ← NV-8200 - 10 ← P3 - 3 ←
by 1/3 speed of normal

IC10 - 3 1 → IC12 - 3 , 2 → Q14 ON → L Rew signal

IC8, R69, R70, C16 at IC13 - 7 stage perform as a waveform shape.

High level signal at IC13 - 6 is supplied to IC2 - 12 and IC9 - 9 respectively. These signals prohibit slow and pause memory reset during slow Rew.

The signal at IC12 - 6 performs to memorize pause memory during slow Rew. Also the low level signal at IC10 - 3 is supplied to IC12 - 5 , and the following process proceeds. (See Fig.158.)
As shown in Fig.149 Play set pulse and pause set pulse set pulse appear after slow Rew is released.
This pause pulse is shorted by C12, R15 to improve acceptance time of EDIT start pulse.

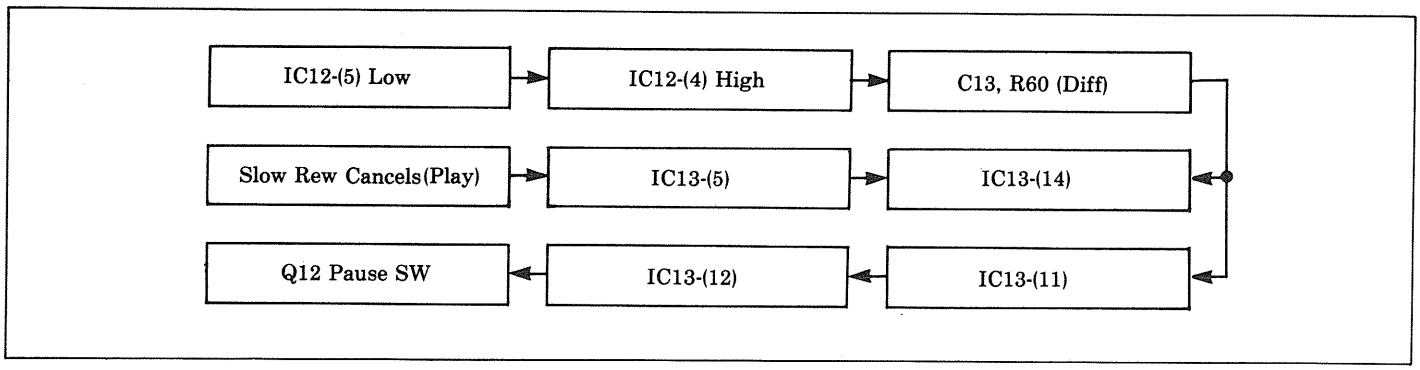



Fig. 158

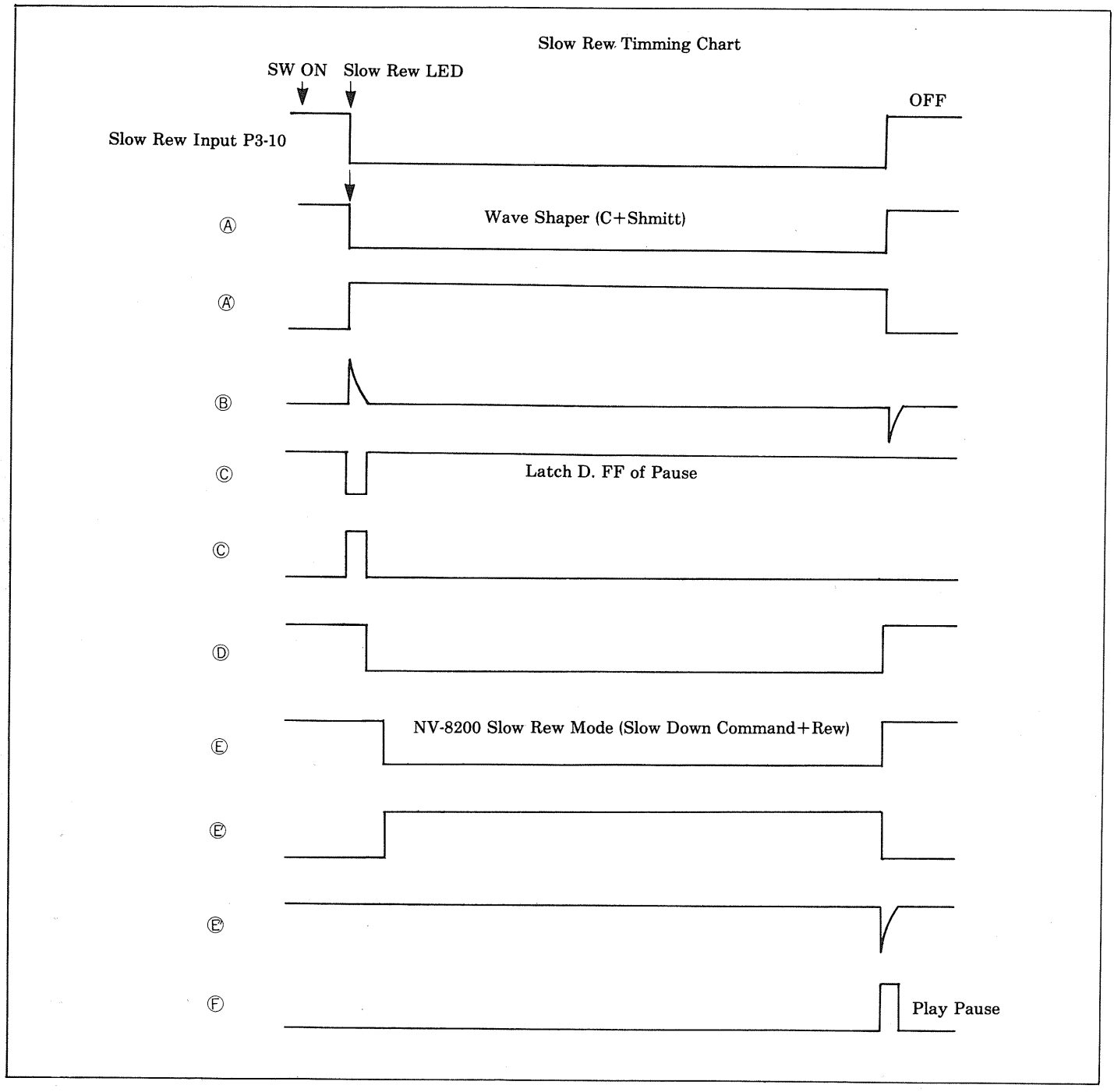



Fig. 159

Automatic editing

A) DUB SELECT SW EDITOR

PRE ROLL END

ASSEMBLY START BUTTON (EE mode)

EDITING POINT (REC/PLAY mode)

B) DUB SELECT SW → SOURCE

UNTIL EDITING POINT (VV mode)

In pre-roll end mode, pause mode, pause mode is kept by negative pulse for pause from NV-A950 until start button is pushed.

Play mode starts for 5 seconds by EDIT start.
In this five seconds, a picture is in the E-E mode by controlling the interface adaptor and controls the servo by V sync.

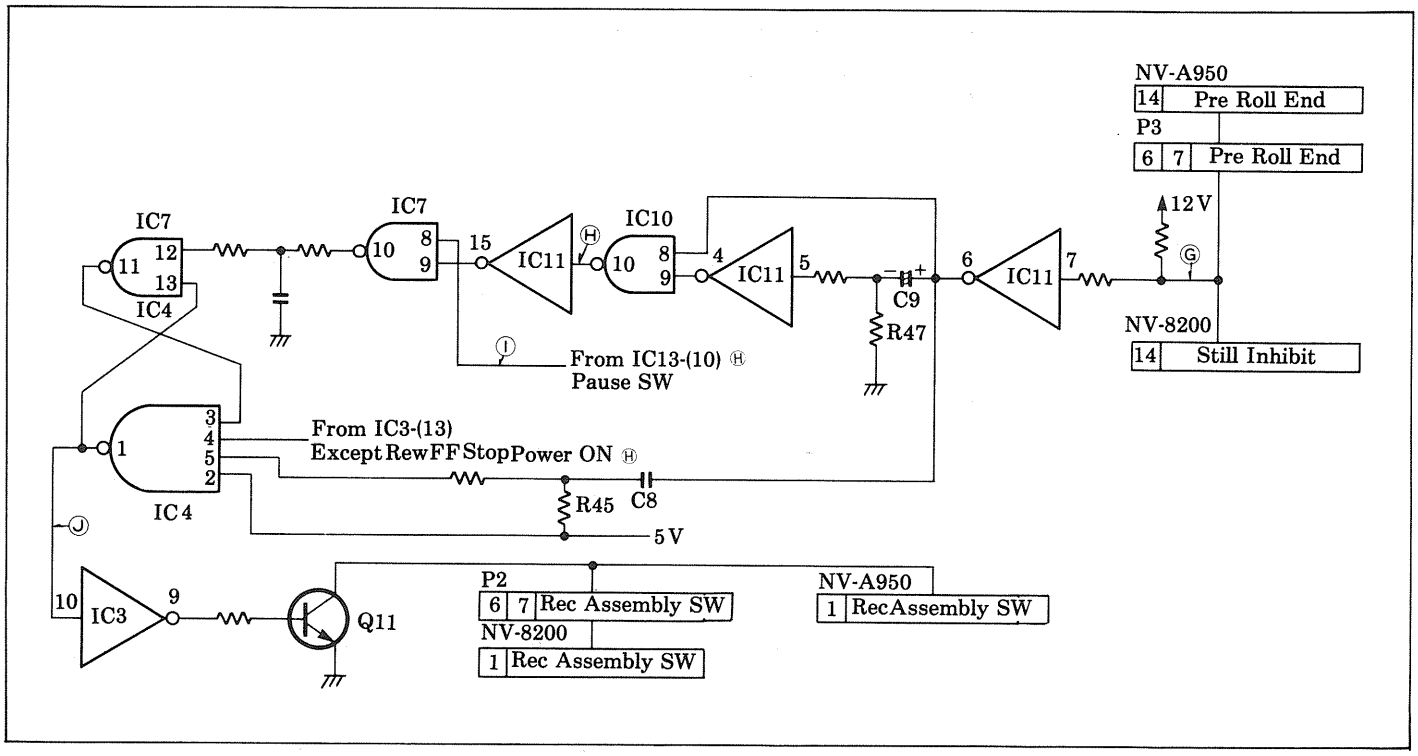



Fig. 160

Low level signal (Pre Roll End) from NV-A950 - 14 is supplied to ICN - 7 through P3 - 6 7.

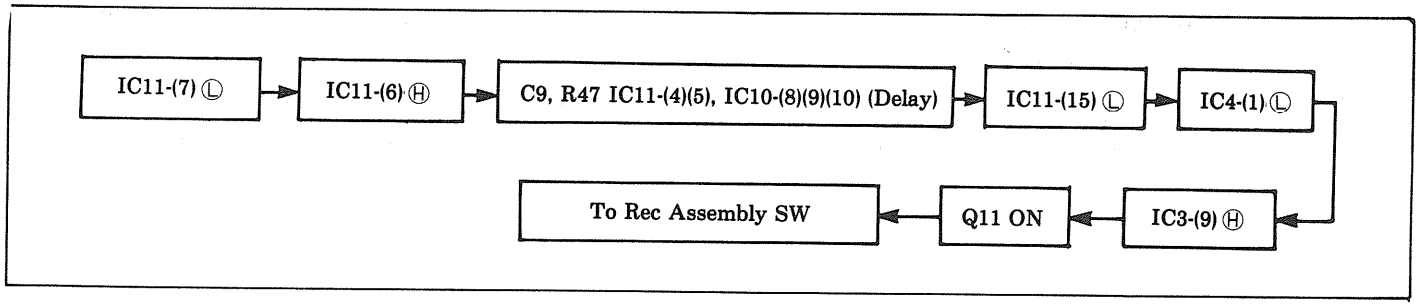



Fig. 161

As shown in Fig.161.Rec. Assemble SW is memorized in the EE mode by driving Rec. SW. And if it reaches the editing point, REC + PLAY mode are performed by suppling the signal from NV-A950.

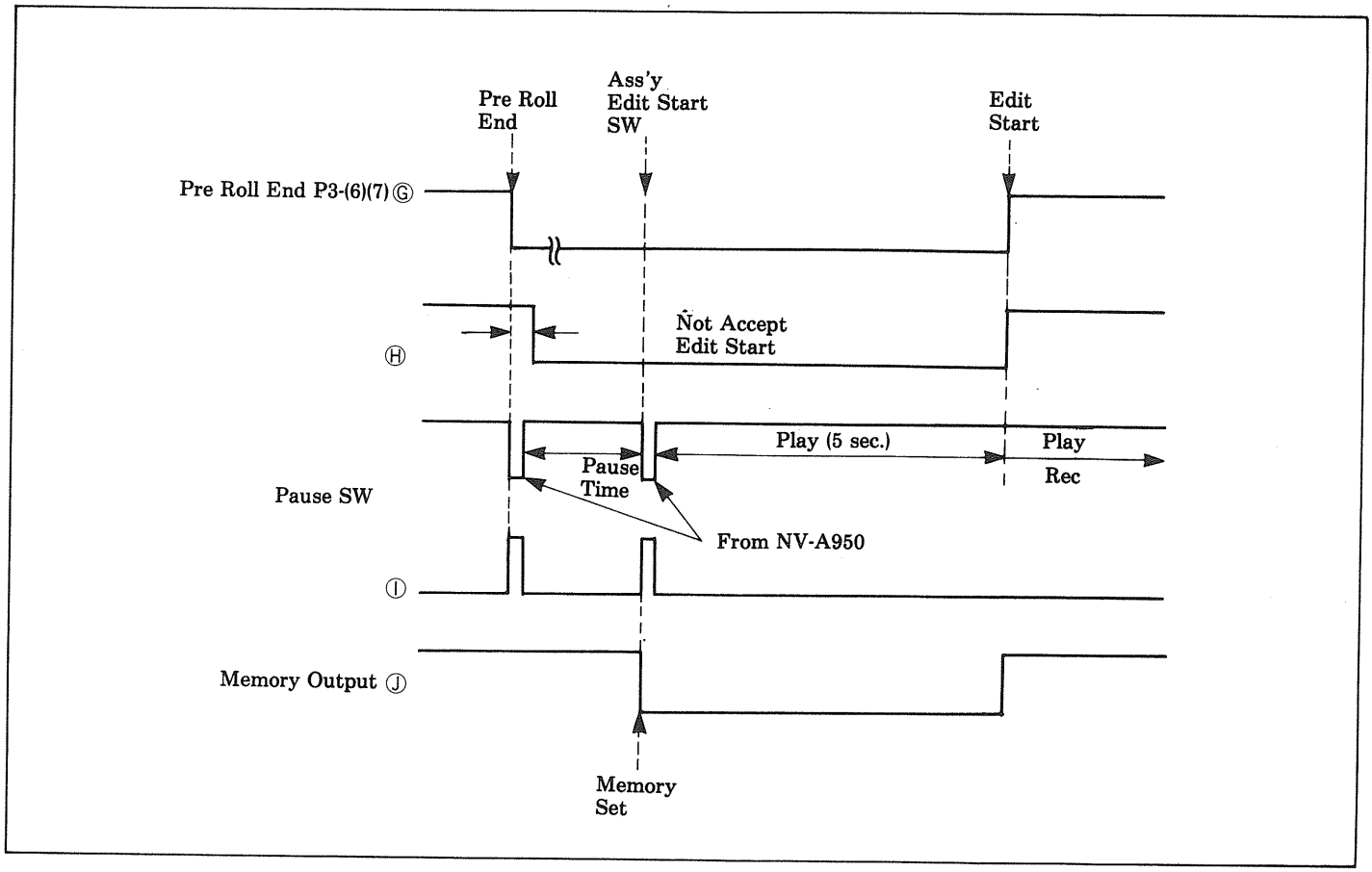



Fig. 162

Pause mode

When pause button is pushed, low level signal enters at IC6- 11 : Then high level signal is supplied to IC6 - 5 to memorize pause mode. Low level signal appears at IC6 - 2 and is supplied to IC9 - 12.

On the other hand, high level signal at IC3 - 12 finally turns Q7, Q7 on to light pause LED.

Positive pulse at IC12 - 10 is supplied to IC6 - 3 as a result of this, pause mode is memorized and Pause LED is lighted.

IC6 - 4 resets pause memory by the high level input signal. Therefore, IC9 - 8 , 9 is releasing pause memory by reset signal except in slow Rew mode.

IC9 - 4 10 , IC3 - 4 5 performs to prohibit the stop pulse when slow Rew button is pushed.

MECHANICAL DESCRIPTION

1. Sub-Loading Mode

This section describes the operations of mechanical parts and some electrical parts when the unit is Loading.

As the tape is placed in to the cassette holder, S609 turns ON (to Ground) so the Sub-loading motor turns counterclockwise (sub-loading gear No. 1). Then all of the sub-loading gears turn. (See below.) Therefore, the Threading lever is moving to side A.

Sub-loading gear No. 1 (turns to the left)

↓ Counterclockwise

Sub-loading gear No. 2 (turns to the right)

↓ Clockwise

Sub-loading gear No. 3 (turns to the left)

↓ Counterclockwise

Sub-loading gear No. 4 (turns to the right)

↓ Clockwise

Threading lever (moving to direction A)

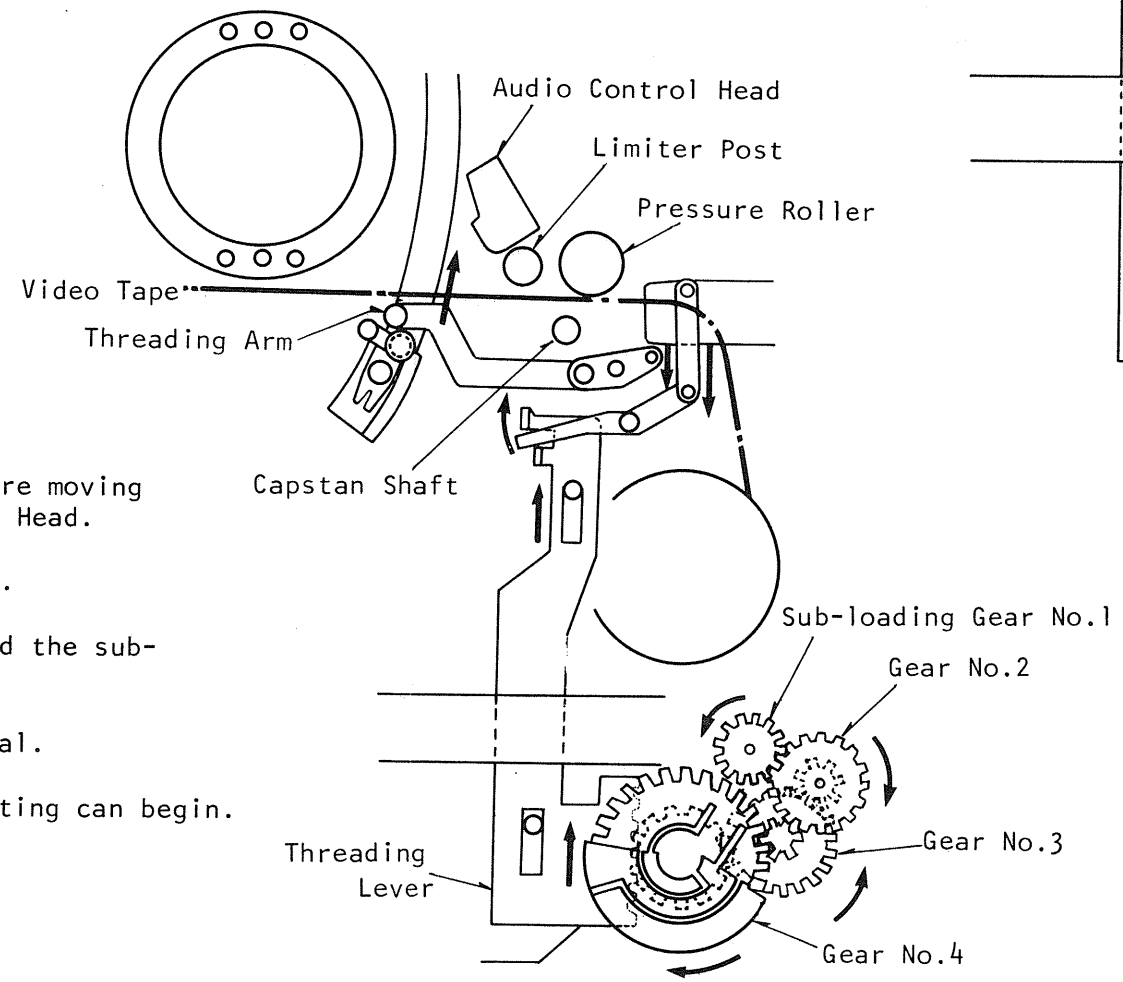
As the threading lever is moving to side A, the related Parts are moving B → C → D. Now the threading arm is moved to the Audio/Control Head.

When you insert the tape, the threading arm moves automatically.

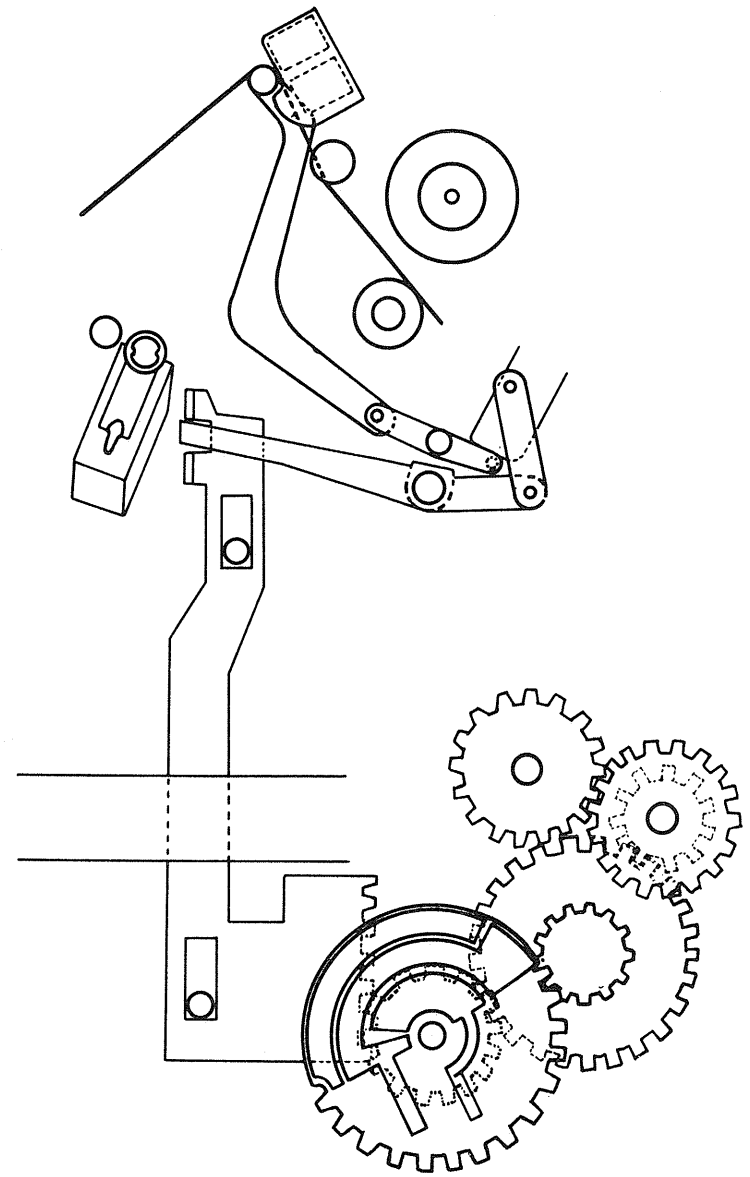
When you push the FF Button or REW Button, the tape moves around the sub-loading arm; this is different from previous models.

As the tape contacts the A/C head, it picks up the control signal.

As the control signal is picked up, exact tape running and counting can begin.




Mechanical Positions When Sub-loading is Started



Sub-loading Completion

2. Play Mode

When the mechanism is in the play mode, the following is required:

1. Brake A and B must be open.
2. Loading must be completed.
3. The take-up reel must be turning clockwise.
4. When the Pressure Roller Solenoid is pushed, the pressure roller must contact the capstan shaft.

Opening the Supply and Take-up Reel Brakes.

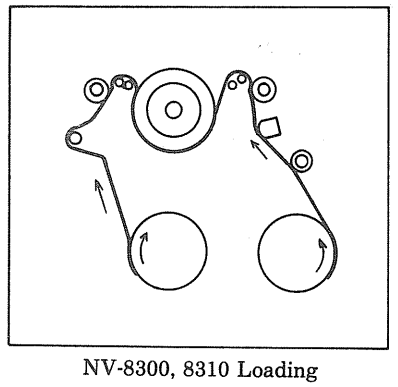
When the play button is pushed, the main solenoid is activated, the brake release lever moves to 1 and brake lever A moves to 2. Therefore, the brake opens.

Movement of Loading and Loading Completion

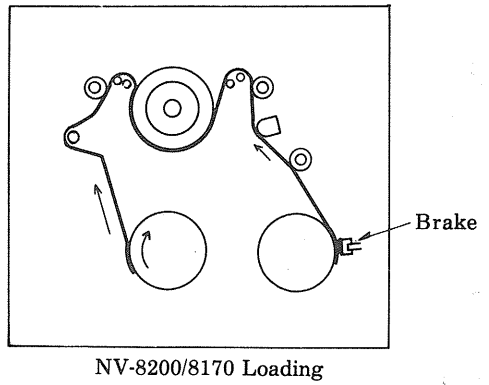
The movement of loading is about the same as that of models NV-8300, NV-8310.

A particular difference is that the tape on the take-up reel side does not move because there is a brake on the take-up reel. Therefore, miscounting does not occur.

When loading is completed, the loading solenoid will de-energize and release the take-up reel brake. (Refer to Fig. No.2.)



NV-8300, 8310 Loading




NV-8200/8170 Loading

Stop Mode of Mechanism

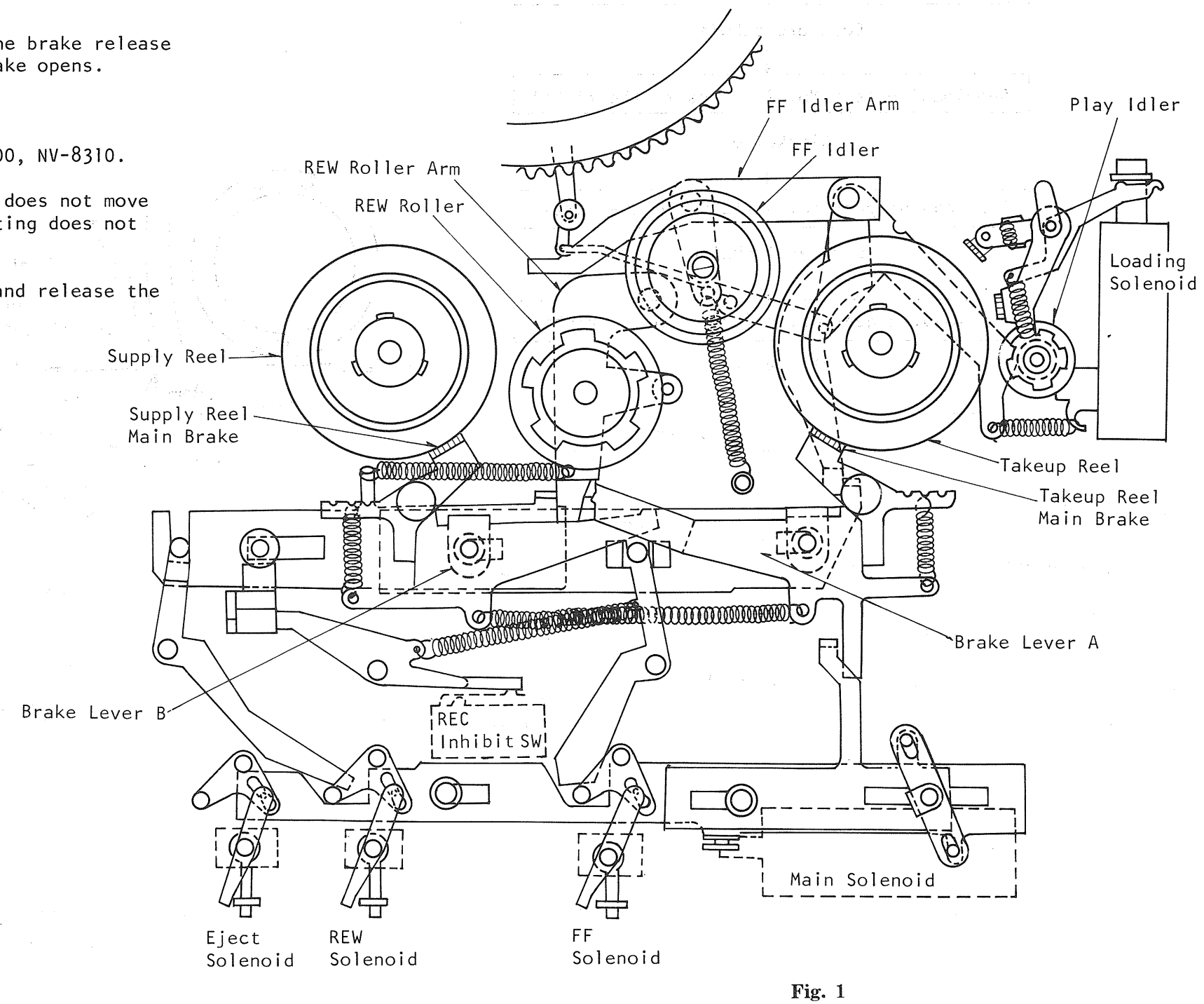



Fig. 1

Play Mode Mechanism

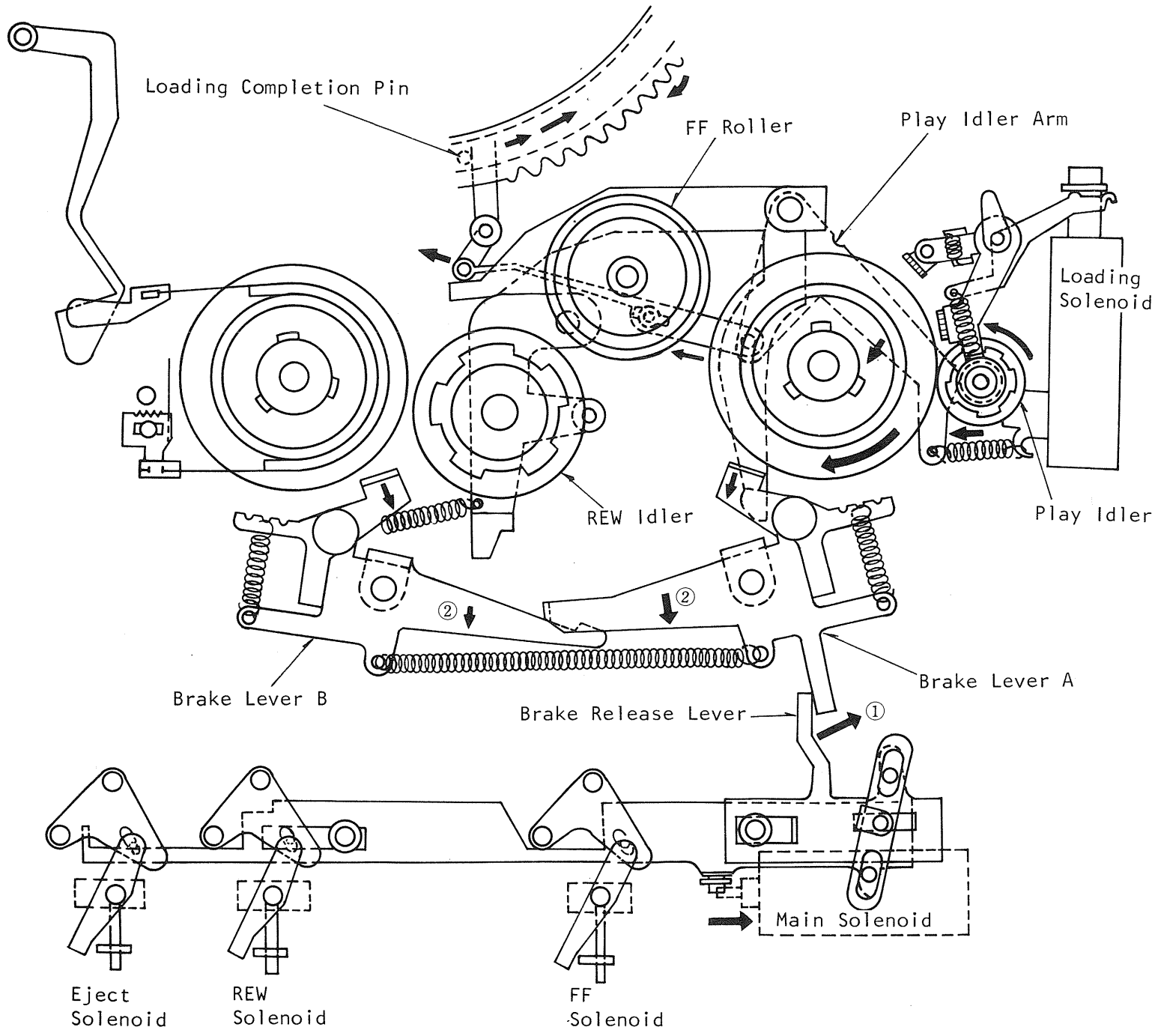
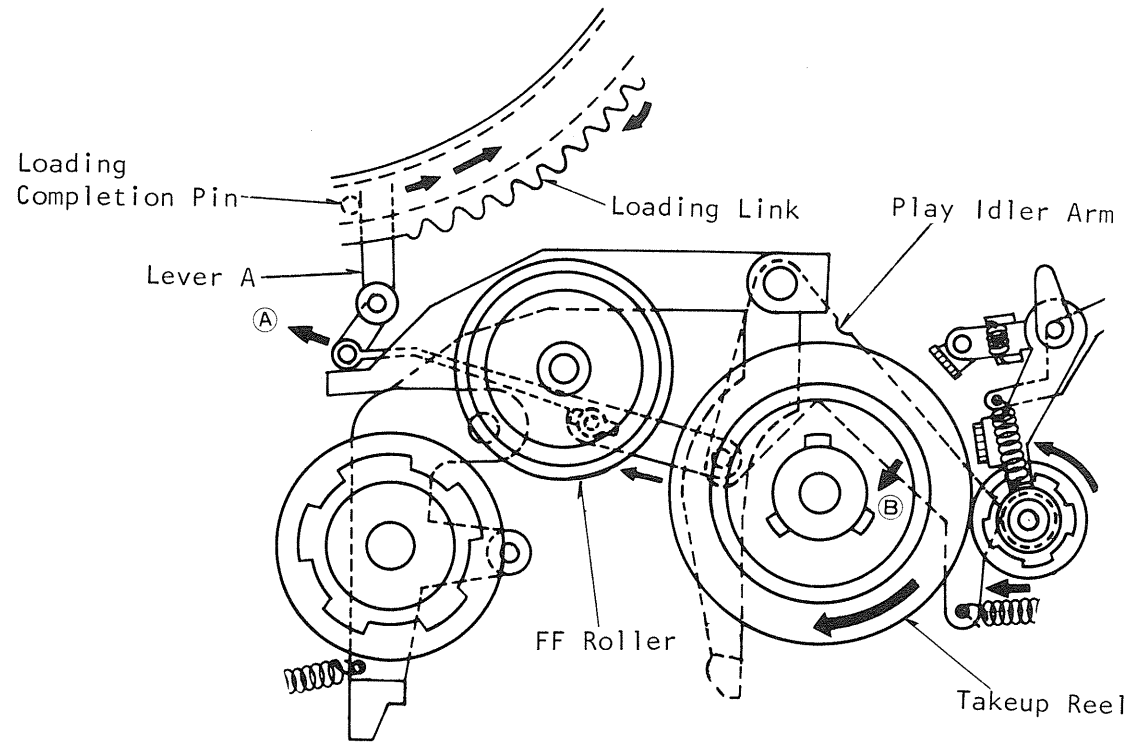



Fig. 2

3. Mechanism for Take-up

At the end of loading, the play idler touches the take-up reel table. The loading completion pin hits lever A. Then lever A moves to position A. The play idler arm moves to position B. Therefore, the play idler touches the take-up reel.

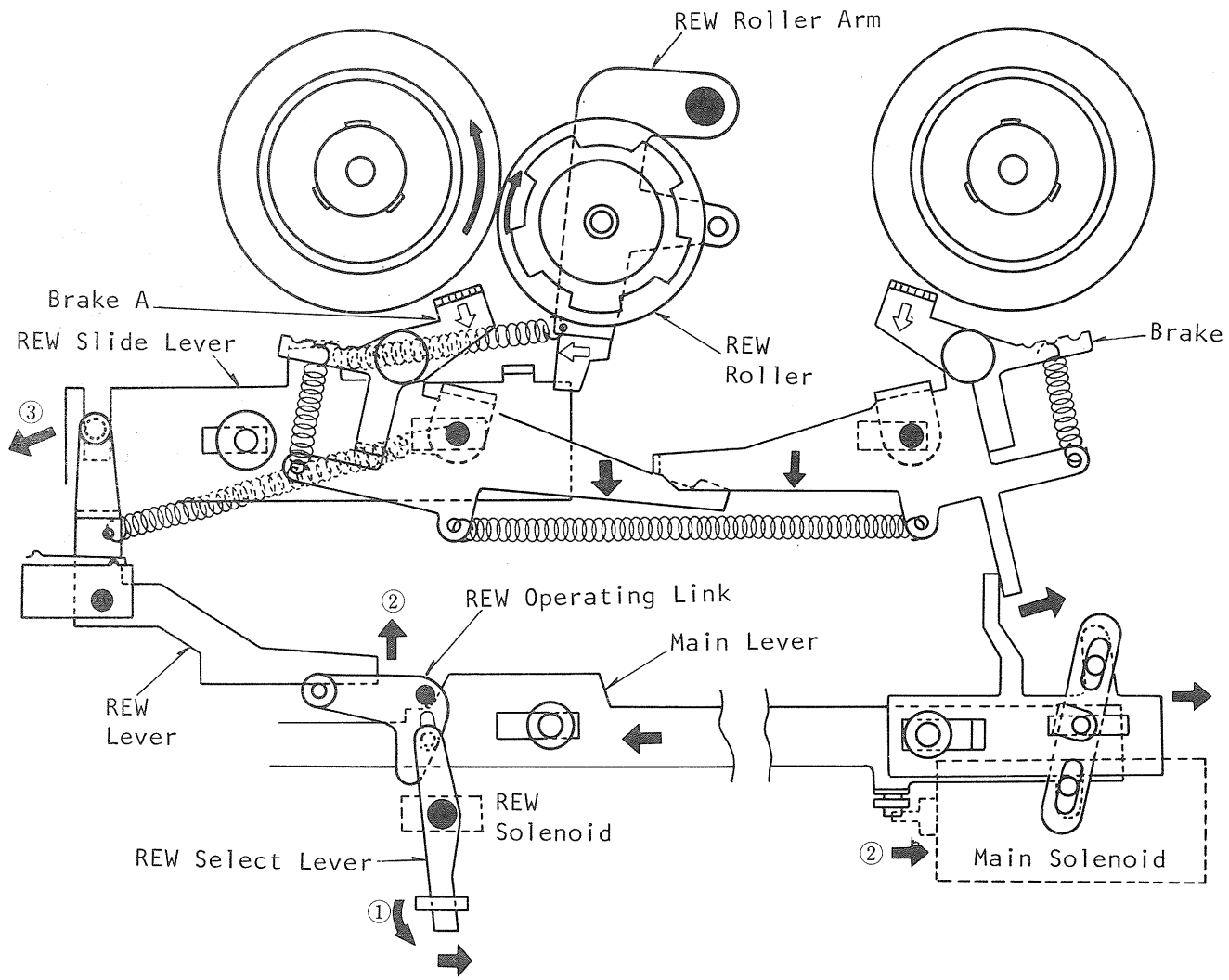
Takeup Reel Rotating Mechanism



## 4. Mechanism for Rewind

When you push the rewind button, the rewind select solenoid is activated. The main solenoid is also activated. The main lever moves to the left and the rewind operating link moves to position 1. The rewind lever moves to position 2. The rewind slide lever moves to the left. Then the rewind roller makes contact to the supply reel table. As the main solenoid is activated, brake A and B also open.

Rewind Mode Mechanism

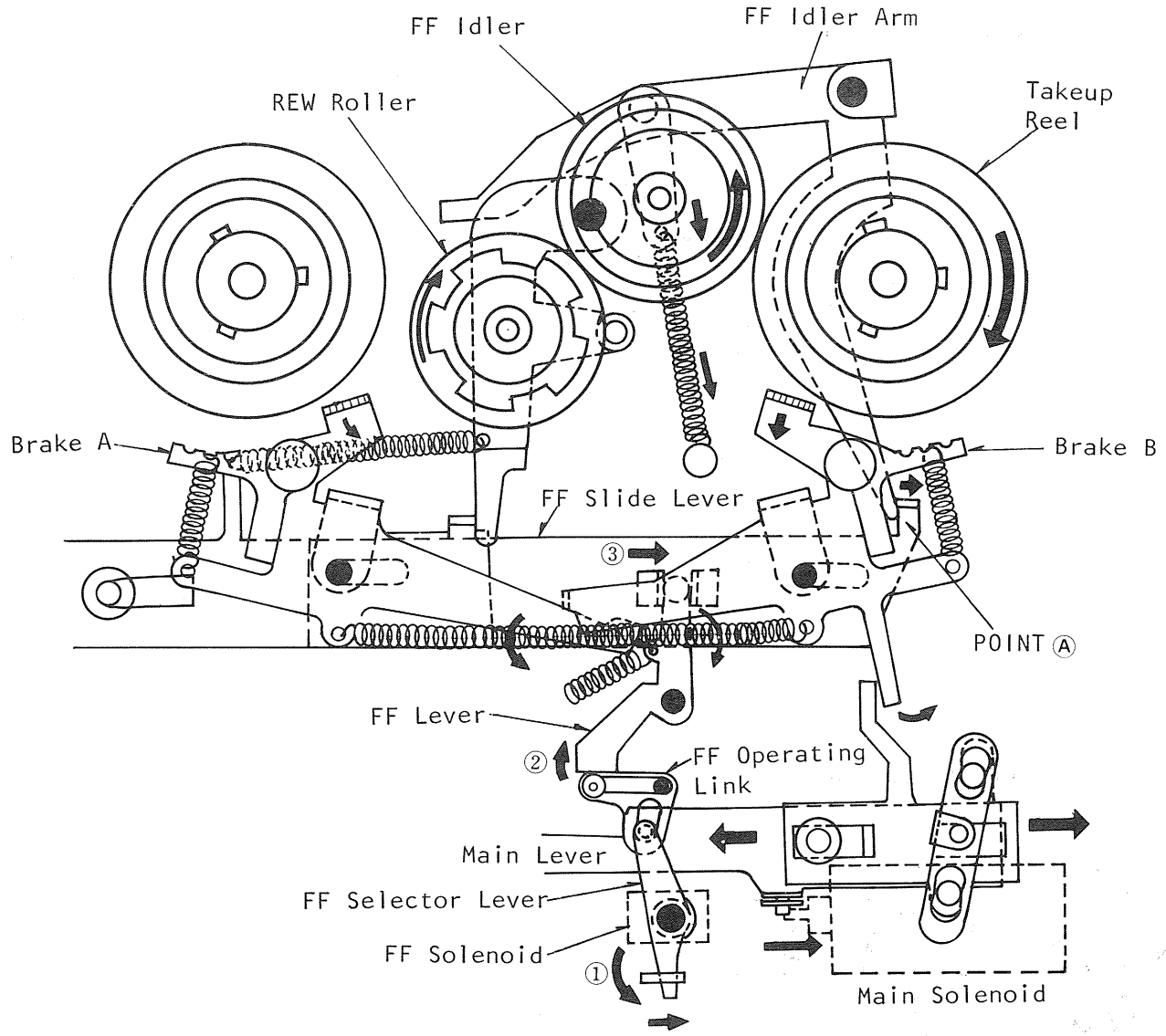



● The black dots represent the fulcrum of the lever or arm.

## 5. Mechanism for Fast Forward

When you push the FF button, the FF select solenoid is activated. Then the main solenoid is also activated. The main lever moves to the left and the FF operating link moves to position 1. The FF lever moves to position 2. Then the FF slide lever moves to the right. Point A moves to position 3. The FF idler contacts the take-up reel table. The rewind roller turns clockwise and contacts the FF idler which causes the FF idler to turn counterclockwise.
As the main solenoid is activated, brake A and B also open.

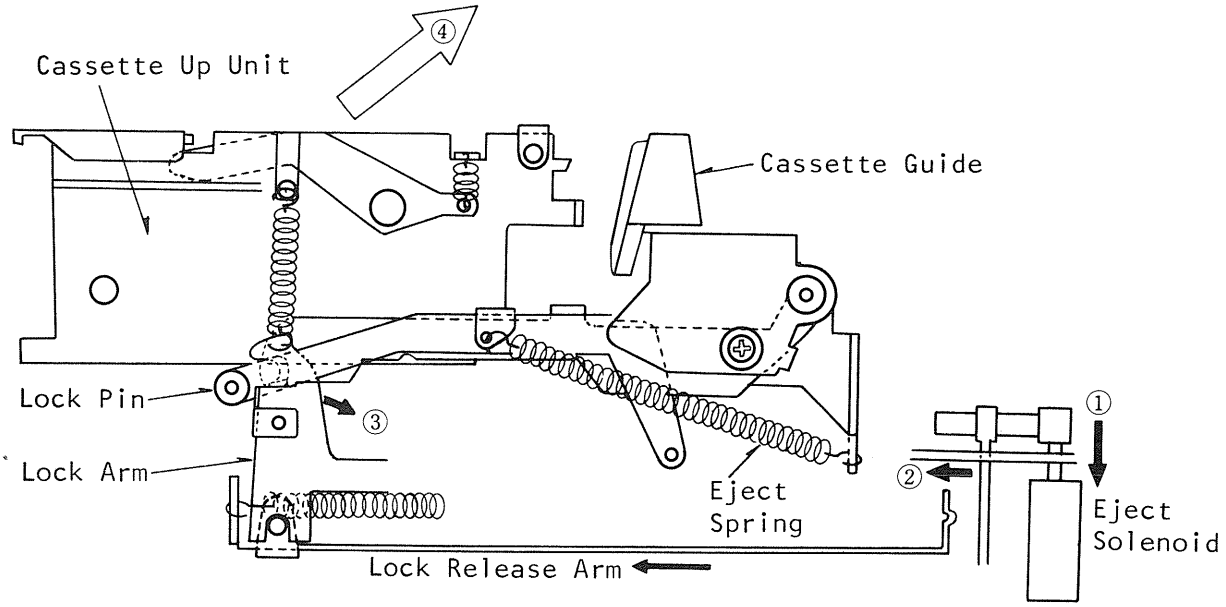
F.F Mode Mechanism



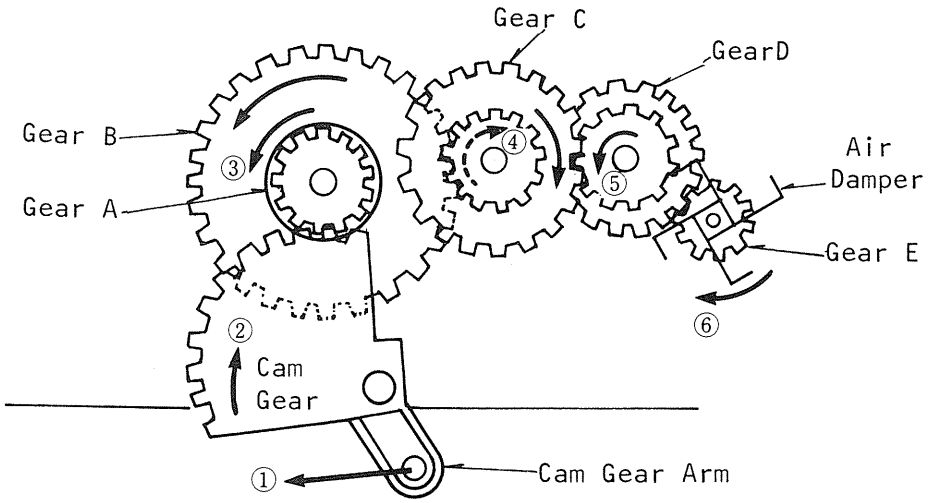

● The black dots represent the fulcrum of the lever or arm.

6. Mechanism for Eject

When you push the eject button, the eject select solenoid is activated. Then the main solenoid is also activated. Then the lock release arm slides to the position 2. Then the lock arm moves to position 3. Therefore, the lock pin is released from the lock arm.
The eject spring causes the cassette holder to pop up. When the cassette tape is in the cassette, the holder, the sub-loading lever returns to its previous position. Then the cassette tape pops up.
The eject air damper causes the cassette to pop up slowly.



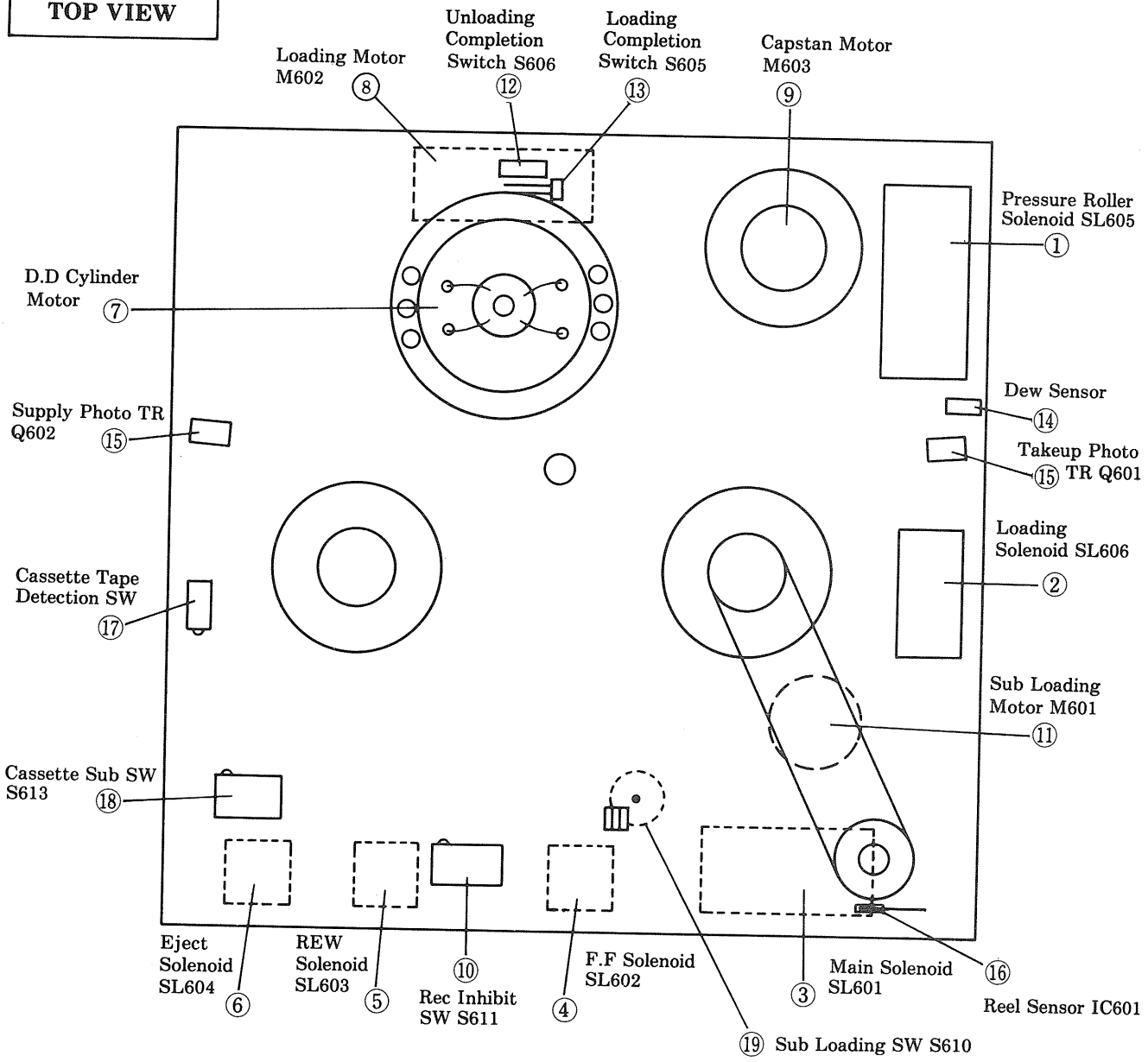

When the cassette holder pops up, the cam gear arm moves to position 1. Then the cam gear turns clockwise. Gears A and B turn counterclockwise. Gear C turns clockwise. Gear D turns counterclockwise. Therefore, the air damper turns clockwise.
When the cassette holder is down, the cam gear turns counterclockwise. Then gear A turns clockwise. Gear B does not turn.



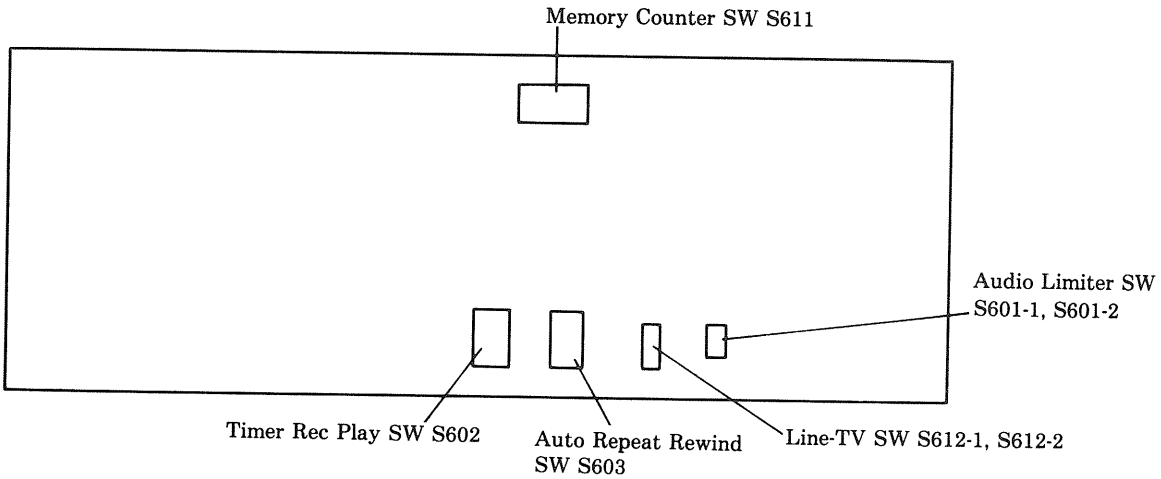
LIST OF FUNCTIONS

| No. | Part Name | Functions |
|---|---|---|
| 1 | Pressure Roller Solenoid | At the end of loading, the Pressure Roller Solenoid is activated. Then the Pressure Roller Solenoid contacts the capstan shaft. Therefore, the tape runs.<br>In the Pause Mode the Pressure Roller Solenoid is released.<br>In the still mode the Pressure Roller Solenoid maintains contact of the Pressure Roller to the capstan shaft. |
| 2 | Loading Solenoid | The loading solenoid is activated in the loading mode and unloading mode. Therefore, the loading solenoid serves as a brake for the take-up reel table. |
| 3 | Main Solenoid | In the play mode, FF mode, rewind mode and eject mode, the main solenoid is activated. Therefore, the main solenoid effects all of the above modes. |
| 4 | FF Solenoid | In the FF mode, the FF select solenoid activates. Therefore, the FF select solenoid effects the FF mechanism movement. |
| 5 | Rewind Solenoid | In the rewind mode, the rewind select solenoid activates. Therefore, the rewind select solenoid effects the rewind mechanism movement. |
| 6 | Eject Solenoid | In the eject mode, the eject select solenoid activates. Therefore, the eject select solenoid effects the eject mechanism movement. |
| 7 | D.D Cylinder Motor | In the play mode or REC mode, the D.D. cylinder rotates. |
| 8 | Loading Motor | In the loading mode or unloading mode, the loading motor rotates. |
| 9 | Capstan Motor | While the tape is running, the capstan motor effects each reel tables movement. |
| 10 | REC Inhibit Switch | If the tab is removed, the REC Inhibit switch is OFF. Therefore, recording cannot be activated. |

## TOP VIEW


Loading Motor M602 ⑧
Unloading Completion Switch S606 ⑫
Loading Completion Switch S605 ⑬
Capstan Motor M603 ⑨
Pressure Roller Solenoid SL605 ①
D.D Cylinder Motor ⑦
Dew Sensor ⑭
Supply Photo TR Q602 ⑮
Takeup Photo ⑮ TR Q601
Loading Solenoid SL606 ②
Cassette Tape Detection SW ⑰
Sub Loading Motor M601 ⑪
Cassette Sub SW S613 ⑱
Eject Solenoid SL604 ⑥
REW Solenoid SL603 ⑤
⑩ Rec Inhibit SW S611
F.F Solenoid SL602 ④
Main Solenoid SL601 ③
⑯ Reel Sensor IC601
⑲ Sub Loading SW S610

## FRONT VIEW


Memory Counter SW S611
Audio Limiter SW S601-1, S601-2
Timer Rec Play SW S602
Auto Repeat Rewind SW S603
Line-TV SW S612-1, S612-2

Panasonic®

MATSUSHITA ELECTRIC